
EXHIBIT 23



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California Regional Water Quality Control Board Central Valley Region

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FILE

19 August 2009

Mr. Larry Bright
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PHASE II HYDROGEOLOGIC CHARACTERIZATION REPORT – VALLEY WASTE DISPOSAL COMPANY – CYMRIC FIELD STUDY AREA, KERN COUNTY

The enclosed memorandum prepared by Central Valley Regional Water Quality Control Board (Central Valley Water Board) staff contains a review of the 24 April 2007 Phase II Hydrogeologic Characterization Report for the Valley Waste Disposal Company (VWDC) McKittrick 1 Facility prepared by Geomega Inc.

As a result of the review, Central Valley Water Board staff has the following recommendations:

- 1) Determine the wastewater depth and collect wastewater samples semi-annually from monitoring wells CYM-19H1 and CYM-17N1. Determine the groundwater depth and collect a groundwater sample from monitoring well CYM-21D1. Have the samples analyzed for general minerals, petroleum hydrocarbons, and the stable isotopes of oxygen and hydrogen.
- 2) Sound sentinel wells CYM-17K1, CYM-17Q1, and CYM-17M1 semi-annually for the presence of liquid. Should liquid be present in any well, the depth needs to be determined and a sample collected and analyzed for the same constituents as indicated in Recommendation 1.
- 3) Submit semi-annual monitoring reports to the Central Valley Water Board staff containing the laboratory certified analytical results, water level elevations, and any appropriate narrative. The report also needs to contain the daily discharge rate to the McKittrick 1 Facility during the reporting period.
- 4) Should wastewater migrate to any of the sentinel wells, VWDC needs to submit a work plan for evaluating the extent of the wastewater plume.

By 16 October 2009, please submit a sampling and analysis plan for the monitoring wells at the McKittrick 1 Facility that considers the above recommendations. If you have any questions, please call Jim Dowdall of this office at (559) 445-5108.


JAMES K. DOWDALL
Engineering Geologist
Professional Geologist #4830


SHELTON R. GRAY
Senior Engineering Geologist

Enclosure



California Environmental Protection Agency



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TO: Shelton R. Gray
Senior Engineering Geologist

FROM: James K. Dowdall
Engineering Geologist
Professional Geologist #4830

DATE: 19 August 2009

SIGNATURE: 

SUBJECT: **PHASE II HYDROGEOLOGIC CHARACTERIZATION REPORT – VALLEY
WASTE DISPOSAL COMPANY – CYMRIC FIELD STUDY AREA, KERN
COUNTY**

BACKGROUND

Valley Waste Disposal Company (VWDC) operates four oil field wastewater disposal pond facilities (McKittrick 1, McKittrick 1-1, McKittrick 6, and McKittrick 7) northwest of the town of McKittrick in western Kern County (see attached Figures 1 and 2). The ponds receive wastewater high in total dissolved solids (TDS) from numerous hydrocarbon production facilities in the Cymric Oil Field. The initial characterization work is being focused on the VWDC McKittrick 1 facility (1 and 1-3) (Facility) where the current disposal rate is approximately 60,000 barrels/day. Disposal operations at this facility have been on-going since the 1950's.

A Phase I Hydrogeologic Characterization conducted during November 2002, involved drilling and installing three monitoring wells (CYM-19H1, CYM-17N1, and CYM-21D1) northeast of the Facility (see attached Figure 4 from Phase II Characterization Report). The Facility is in Section 19, T29S, R22E, MDB&M off the east flank of the Cymric Oil Field. The purpose was to determine the extent of subsurface wastewater migration from the ponds.

Central Valley Regional Water Quality Control Board (Central Valley Water Board) staff concluded in part, in 24 August 2004 correspondence to VWDC regarding the Phase I characterization that:

- 1) Wells CYM-19H1 and CYM-17N1 monitor produced oilfield wastewater migrating from the Facility.
- 2) The wastewater has migrated deeper in CYM-19H1 than CYM-17N1 but, probably no deeper than the Corcoran Clay Equivalent.
- 3) The wastewater has migrated laterally at least as far as CYM-17N1 but not as far as CYM-21D1 (between approximately 4,000 – 6,600 feet).
- 4) The lateral extent of wastewater migration is unknown.

In response to the Phase I Hydrogeologic Characterization, Central Valley Water Board staff recommended that VWDC install additional wells between CYM-17N1 and CYM-21D1 to determine the lateral extent of the produced wastewater migration. Borings for the Phase II Hydrogeologic Characterization were to be drilled as deep as the top of the Corcoran Clay Equivalent using the same procedures as used during Phase I.

SUMMARY OF PHASE II HYDROGEOLOGIC CHARACTERIZATION REPORT

The Phase II Hydrogeologic Characterization Report (Report), dated 24 April 2007, was prepared by Geomega Inc., for VWDC. The characterization field work was conducted during August and September 2006 and involved the drilling and installation of three wells (CYM-17K1, CYM-17Q1, and CYM-17M1) to delineate the lateral extent of wastewater migration beyond Well CYM-17N1. The location of the wells is shown on attached Figure 4 from the Phase II report.

CYM-17K1

Between August 3 and August 6 of 2006, exploratory boring CYM-17K1 was air-drilled from 0 to 20 feet (ft.) and continuously cored from 20 to 228 ft. Photographs of the cored interval are contained in Appendix A of the Report. The remainder of the boring was drilled with mud rotary from 228 to 350 ft. total depth with soil samples collected at 10-foot intervals. After conditioning the mud, the borehole was logged using electrical resistivity, bulk density, neutron porosity, gamma ray, spontaneous potential, and caliper tool.

After evaluating the cores and geophysical logs, it was determined that first encountered groundwater occurred at a depth of approximately 245 ft. in the Tulare Formation. Exploratory borehole CYM-17K1 was plugged and abandoned and a twin borehole was air-drilled to a total depth of 210 ft. about 10 ft. south of the original location. Twin borehole CYM-17K1 was completed as a dry, vadose zone monitoring well screened from 150 to 200 ft. It is completed in the same stratigraphic interval as upgradient well CYM-17N1, a well that has been impacted by wastewater migration from disposal operations at the Facility.

The impact at well CYM-17N1 consists of 25 feet of wastewater perched on top of an Upper Tulare clay from 165 to 200 ft., and has apparently not migrated as far as well CYM-17K1 (refer to attached Modified Figure 3). At well CYM-17K1, the Upper Tulare perching clay occurs from approximately 188 to 225 ft.

Discussion of Stratigraphic Interpretation

During the coring of well CYM-17K1, it was determined that the Corcoran Clay Equivalent (CCE) occurs much higher in the section than was previously thought. Using the Phase I characterization data, the CCE would have been projected to occur at approximately 260 ft. (+171 mean sea level (MSL)) in CYM-17K1 when it actually occurs at 82 ft. (+349 MSL), 178 ft. shallower than originally correlated.

I used stratigraphic picks from the AERA 1A2 monitoring well, where the top of the CCE occurs at 167 (+285 MSL), to correlate with CYM-17K1. Well 1A2 is located about 1.5 miles north of the Facility (see Figure 1 for location - blue circle). There is a structural rise in the CCE of 70 ft. moving south towards the Facility from well 1A2, a distance of approximately 12,320 ft. This is a very flat rise, with a gradient of .0057 or 0.33 degree dip.

High API gamma ray units occurring in AERA well 1A2 from 165 to 200 ft. were correlated with the high API gamma ray units occurring in VWDC well CYM-17K1 from 80 to 130 ft. to identify the CCE zone. Photographs of the cores provided in Appendix A of the Report, show the cored interval from depths of 80 to 118 ft. to consist of light gray to dark brown silt to very fine silt, except for the sand from depths of 98 to 103 ft. The 80 to 118-foot section appears to be the CCE interval. Above the CCE, the interval cored from depths of 30 to 70 ft. consists of light brown to cream colored, fine-grained to medium-grained sand that appears to be dry. This 30 to 70-foot section appears to be the 22K Sand interval or its equivalent. A comparison of the CYM-17K1 geophysical log with the core photos through these intervals shows good correlation.

CYM-17Q1

From August 17 to August 20 of 2006, exploratory boring CYM-17Q1 was air-drilled from depths of 0 to 200 ft. and then drilled with mud rotary from 200 to 350 ft. total depth. Soil samples were collected at 10-foot intervals and kept in plastic bags. After conditioning the mud, the borehole was logged with electrical resistivity, bulk density, neutron porosity, gamma ray, spontaneous potential, and caliper tool.

After evaluating the soil samples and geophysical logs, it was determined that first encountered groundwater occurs at a depth of approximately 282 ft. in the Tulare Formation. Exploratory borehole CYM-17Q1 was plugged and abandoned and a twin borehole was air drilled to 208 ft. total depth about 10 ft. south of the original location. Twin borehole CYM-17Q1 was completed as a dry vadose zone monitoring well, screened from a depth of 160 to 200 ft. It was completed in the same stratigraphic interval as upgradient well CYM-17N1. At well CYM-17Q1, the upper Tulare clay (perching layer) occurs from approximately 185 to 212 ft.

CYM-17M1

From August 29 to September 5 of 2006, Exploratory boring CYM-17M1 was air-drilled from a depth of 0 to 200 ft. and then drilled with mud rotary from 200 to 350 ft. total depth. Soil samples were collected at 10-foot intervals and kept in plastic bags. After conditioning the mud, the borehole was logged with electrical resistivity, bulk density, neutron porosity, gamma ray, spontaneous potential, and caliper tool.

After evaluating the soil samples and geophysical logs, it was determined that first encountered groundwater occurs at a depth of approximately 262 ft. in the Tulare Formation. Exploratory borehole CYM-17M1 was plugged and abandoned and a twin borehole was air

drilled to 198 ft. total depth about 10 ft. west of the original location. Twin borehole CYM-17M1 was completed as a dry vadose zone monitoring well, screened from 155 to 185 ft. It was completed in the same stratigraphic interval as upgradient well CYM-17N1. At well CYM-17M1, the upper Tulare clay (perching layer) occurs from 185 to 210 ft.

SUMMARY OF PHASE II MONITORING

Vadose Zone Monitoring - 2006 Phase II Characterization Wells

Three vadose zone wells (CYM-17K1, CYM-17Q1, and CYM-17M1) installed during 2006 as part of the Phase II hydrogeologic characterization indicated that the leading edge of wastewater migration occurs in the southwest corner of Section 17, T29S, R22E, MDB&M near Phase I well CYM-17N1. The wastewater is perched on an upper Tulare Clay layer and has saturated upper Tulare sands lying above the clay layer in Phase I characterization wells CYM-19H1 and CYM-17N1, up-gradient of the Phase II vadose zone wells (see Modified Figure 3 & Figure 4).

The Phase II vadose zone wells are screened in the same stratigraphic interval (above and into the upper portion of the perching clay layer) as CYM-17N1 and CYM-19H1. The Phase II characterization wells have been proposed as sentinel vadose zone monitoring wells, evaluating for any future potential migration of the perched wastewater plume occurring in the up-gradient Phase I wells CYM-17N1 and CYM-19H1.

Phase II Characterization Sampling Of 2002 Phase I Wells

Wastewater samples were collected from the Phase I characterization wells CYM-19H1 and CYM-17N1 on 6 September 2006. A groundwater sample was also collected from well CYM-21D1 on 6 September 2006. The wells were previously sampled in November 2002.

Analytical data from the September 2006 sampling event for wells CYM-19H1 and CYM-17N1 continue to show that they contain oilfield produced wastewater (see attached Table 4 from Phase II characterization report). The elevated TDS, chloride, and boron concentrations in addition to the isotopic enrichment of O^{18} and H^2 are indicative of oilfield wastewater.

Analytical data from the September 2006 sampling event at well CYM-21D1 shows that concentrations of TDS, boron, and chloride have increased since the November 2002 sampling event. However, the 2006 groundwater analytical data is consistent with downgradient background groundwater monitoring well (MW) MW-102RL at the Clean Harbors Buttonwillow Facility. It appears that well CYM-21D1 may not have been sufficiently developed during the initial 2002 sampling event, resulting in lower constituent concentrations due to dilution. The 2006 sampling results appear to be more representative of background groundwater quality.

DISCUSSION OF PHASE II RESULTS

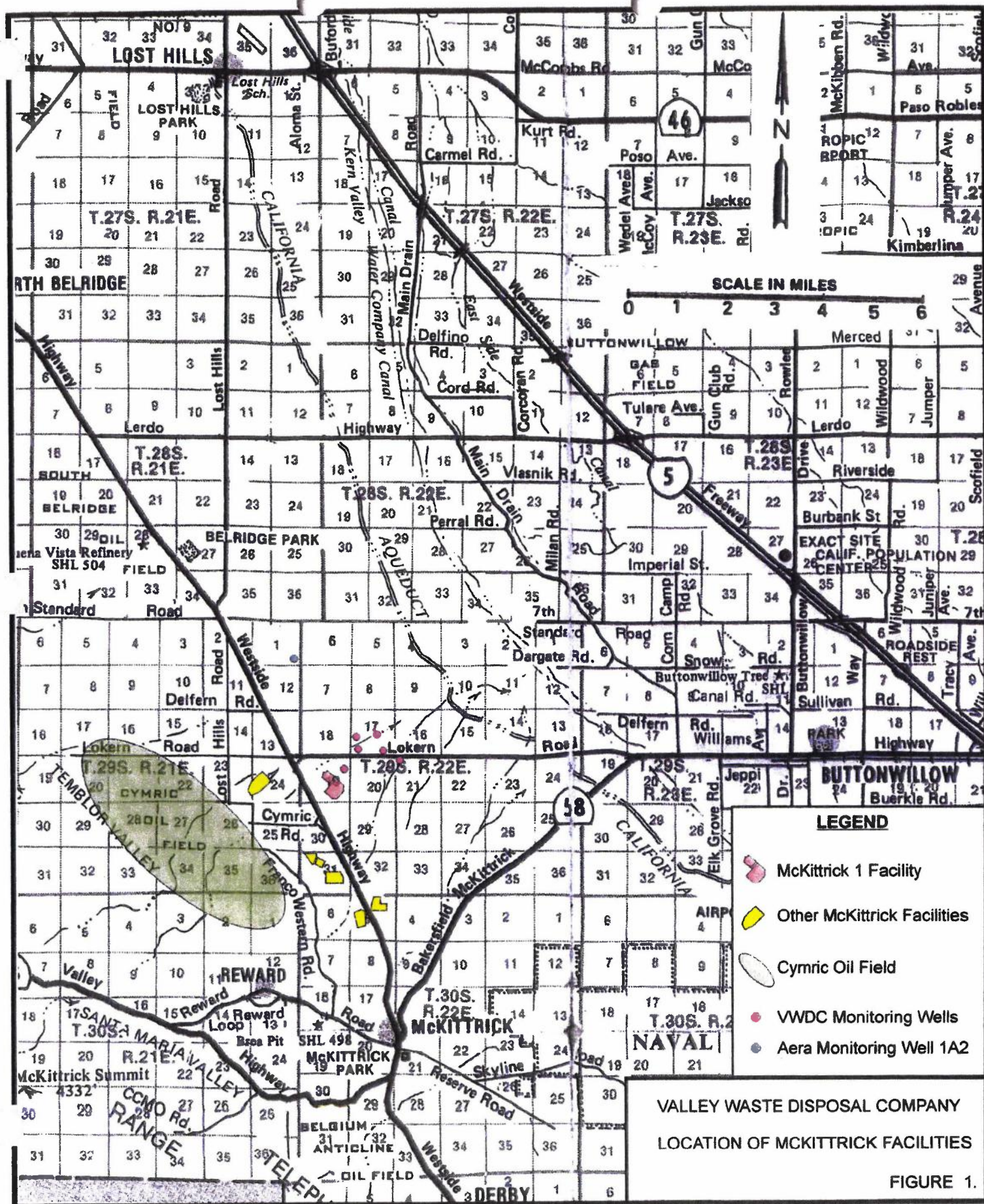
In summary, it was determined during Phase II characterization that:

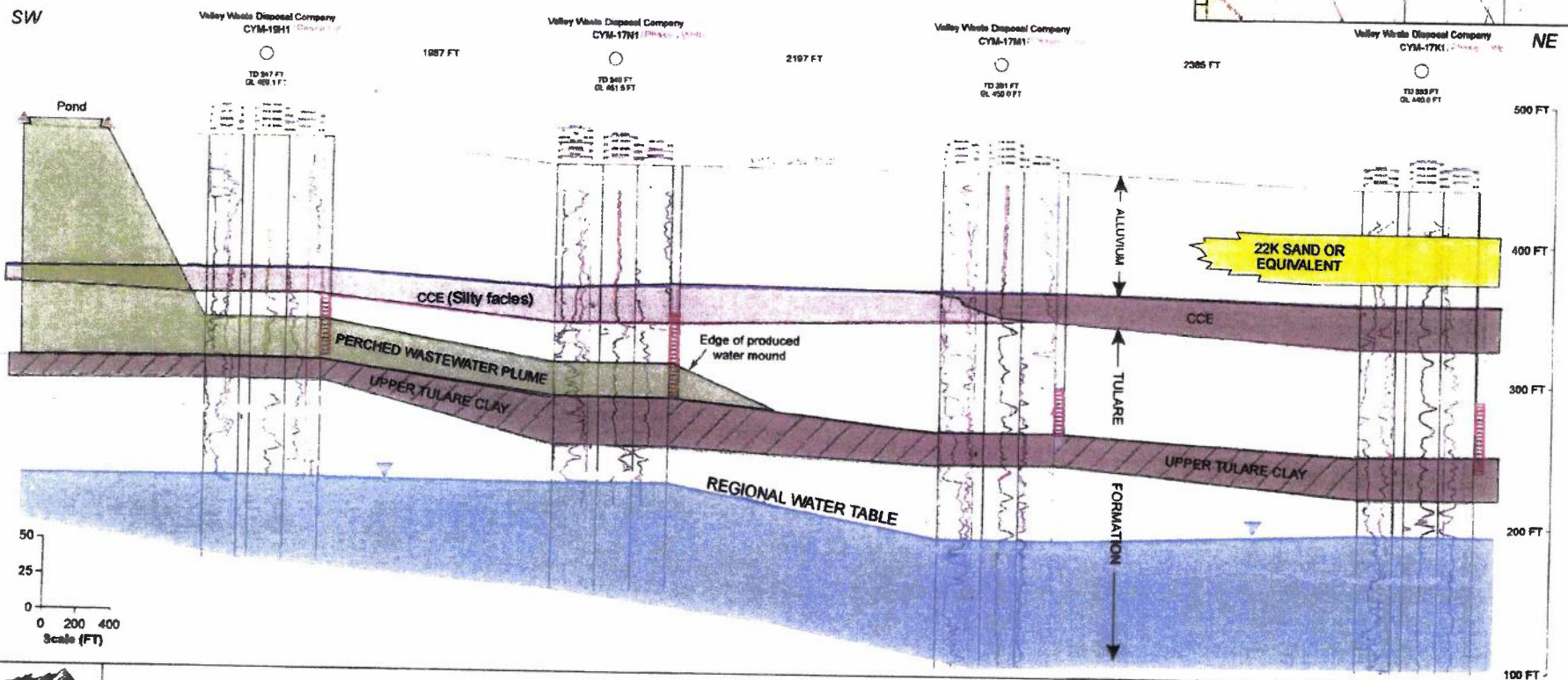
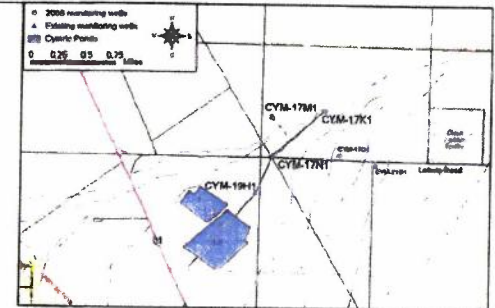
- 1) The CCE occurs much higher in the stratigraphic section than previously thought.
- 2) The CCE appears to have a facies change near well CYM-17M1. The response on the geophysical logs (lower gamma ray API units & silty sand response on density/neutron logs) indicates that the CCE becomes more silty and relatively more permeable south and west of the well.
- 3) Wastewater percolating from the Facility has perched on the Upper Tulare clay and has saturated Upper Tulare sands that were previously dry. The wastewater has migrated laterally approximately 4,000 ft. from the Facility.
- 4) Produced oilfield wastewater has not migrated in the Upper Tulare to any of the Phase II characterization wells.
- 5) The perched wastewater has not migrated to and impacted any groundwater.
- 6) Based on data from the Clean Harbors Buttonwillow Facility, the nearest groundwater perched on the Upper Tulare clay occurs approximately 1.5 miles beyond the Phase II wells.

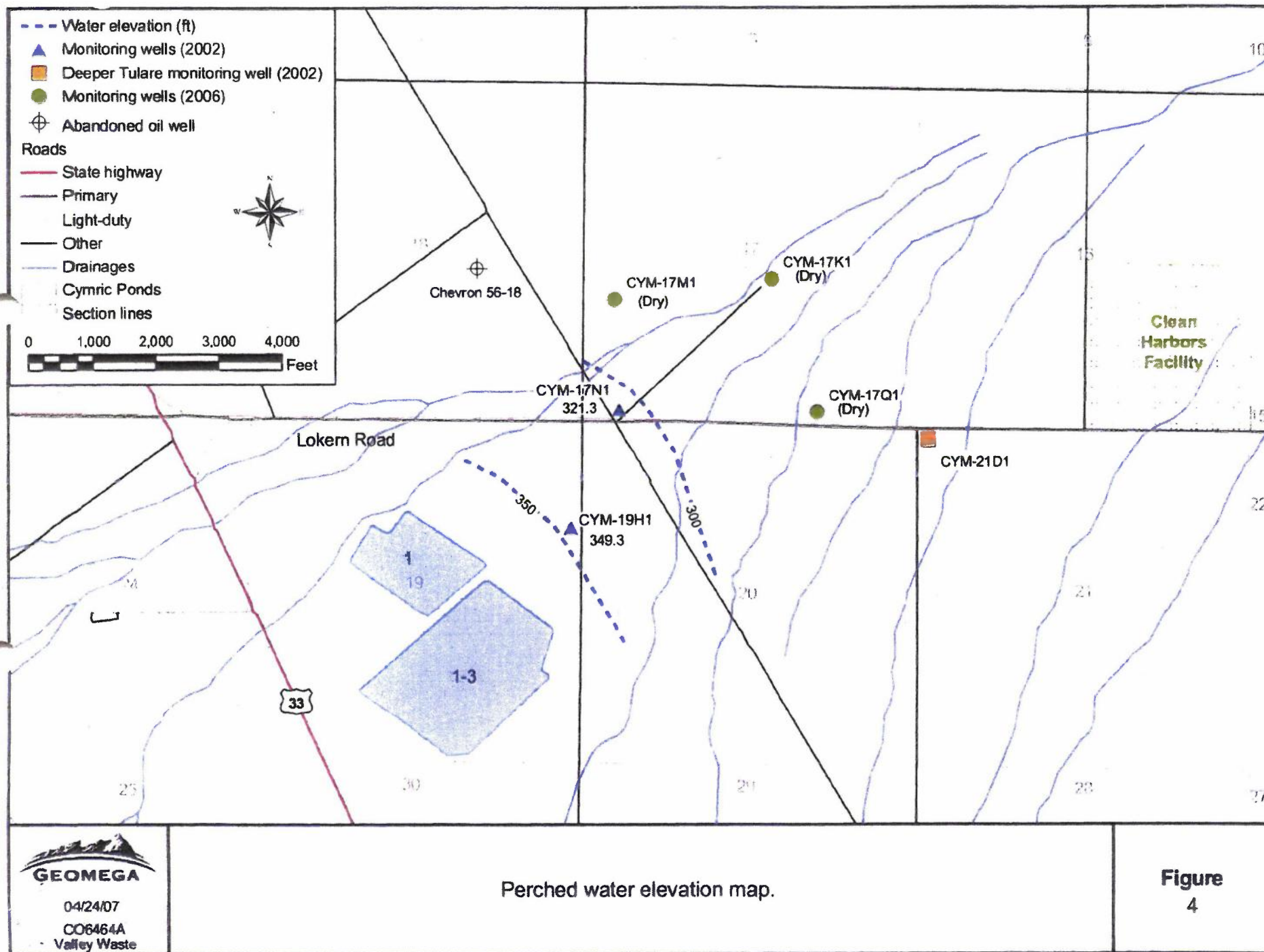
RECOMMENDATIONS

Based upon the results of the Phase II investigation, I have the following recommendations:

- 1) Determine the wastewater depth and collect wastewater samples semi-annually from monitoring wells CYM-19H1 and CYM-17N1. Determine the groundwater depth and collect a groundwater sample from monitoring well CYM-21D1. Have the samples analyzed for general minerals, petroleum hydrocarbons, and the stable isotopes of oxygen and hydrogen.
- 2) Sound sentinel wells CYM-17K1, CYM-17Q1, and CYM-17M1 semi-annually for the presence of liquid. Should liquid be present in any well, the liquid depth needs to be determined and a sample collected and analyzed for the same constituents as indicated in Recommendation 1.
- 3) Submit semi-annual monitoring reports to the Central Valley Water Board staff containing the laboratory certified analytical results, water level elevations, and any appropriate narrative. The report also needs to contain the daily discharge rate to the McKittrick 1 Facility during the reporting period.
- 4) Should wastewater be determined to be present in any of the sentinel wells, VWDC will need to submit a work plan for evaluating the lateral extent of the wastewater plume.







Perched water elevation map.

Figure
4

Table 4. Inorganic analytical data.

Analyte	Cymric Pond 9/6/2006	Cymric Pond 1/14/2003	CYM-17N1 9/6/2006	CYM-17N1 11/25/2002	CYM-19H1 9/6/2006	CYM-19H1 11/26/2002	CYM-21D1 9/6/2006	CYM-21D1 11/24/2002
Boron	67	54	24	20	39	36	10	2.5
Calcium	190	120	810	810	960	760	260	100
Chloride	8100	4520	3500	2700	4900	4120	600	334
Specific Conductance	28000	14600	14000	10900	17000	15600	4400	1970
Magnesium	75	66	230	330	380	260	180	88
Nitrate-N	ND	ND	30	9	16	22	0.23	0.85
Potassium	110	55	5.2	8	9.4	12	3.0	2.1
Sodium	5200	2900	2000	1300	2500	2500	520	170
Sulfate	250	170	2200	2090	2400	2420	1600	423
Total Dissolved Solids	14000	8500	10000	7450	13000	10500	3200	1200
Alkalinity as CaCO ₃	800	570	250	3360	420	2990	130	624
Bicarbonate Alkalinity as CaCO ₃	800	1500	250	400	420	600	130	140
Carbonate Alkalinity as CaCO ₃	ND	ND	ND	ND	ND	ND	ND	ND
Hydroxide Alkalinity as CaCO ₃	ND	ND	ND	ND	ND	ND	ND	ND

All units mg/L; except specific conductance ($\mu\text{mhos/cm}$)

ND - nondetect

**Phase II Hydrogeologic Characterization Report
Valley Waste Disposal Company,
Cymric Field Study Area**

April, 24, 2007

Prepared for:

Valley Waste Disposal Company
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Bakersfield, CA 93308

Prepared by:

Geomega Inc.
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Boulder, CO 80303

Executive Summary

Valley Waste Disposal Company (VWDC) has completed a second phase hydrogeologic investigation (Phase II) of the Cymric Field Study Area, to evaluate groundwater systems in this region of the southern San Joaquin Valley, California. The investigation focused on the VWDC McKittrick 1 and McKittrick 1-3 ponds (Cymric Ponds), seven miles north of the town of McKittrick, CA. These ponds have been receiving excess produced water from local oil and gas companies since the late 1950's.

The investigation followed procedures for field and office tasks as outlined in the work plan submitted to the California Regional Water Quality Control Board, Central Valley Region-Fresno Branch (RWQCB) (Geomega 2006). Field data collected during Phase II involved:

- drilling three boreholes to acquire hydrogeological data from core, cuttings, and geophysical logs,
- installing three vadose zone monitoring wells because the target interval was dry, and
- collecting water samples from three existing Phase I monitoring wells for geochemical analysis.

After acquiring these Phase II field data and revising the site hydrogeology interpretation, it appears that Phase I wells CYM-17N1 and CYM-19H1 are monitoring produced water from the Cymric Ponds in formerly unsaturated Upper Tulare Formation sands. Infiltrating produced water appears to be migrating through the alluvium and perching on an Upper Tulare clay zone that was encountered at ~ 160 to 190 ft below ground surface in the boreholes downgradient of the Cymric Ponds. Beneath this perching clay interval, approximately 80 ft. of unsaturated Tulare sands are present on top of native Tulare groundwater (CYM-19H1, Figure 3). Monitoring well CYM-21D1 is completed in deeper Tulare Formation sands that contain native groundwater.

Water, pond or native, was not encountered in the alluvium or Upper Tulare Formation sands in the three Phase II boreholes, but native groundwater was detected deeper in the Tulare Formation in these boreholes. After the initial boreholes were evaluated and abandoned, twin holes were drilled to the base of the Upper Tulare sands with air rotary methods, and the

boreholes were completed as vadose zone monitoring wells. These dry monitoring wells were completed in the equivalent sands being monitored in two of the upgradient Phase I wells (CYM-17N1 and CYM-19H1, Figure 3).

Water levels from the three Phase I monitoring wells were measured as part of the Phase II field program to track groundwater conditions in the Upper Tulare Formation sands. Water samples were analyzed for geochemical constituents and stable isotopes of oxygen and hydrogen, to determine groundwater composition. Geochemical results from several sampling events in 2002, 2003 (Geomega 2004) and 2006 were plotted on a Stiff diagram (Figure 5), which characterizes water samples according to select ionic types

A hydrogeologic cross-section transecting the Study Area demonstrates that the lateral and vertical extent of the produced water mound originating at the Cymric Ponds has been delineated. The lateral extent of the mound terminates less than 1 mile from the Cymric pond facility (Figure 3). Produced water was not encountered in the alluvium or the upper 120 feet of the Tulare Formation in any of the Phase II boreholes. The three dry monitoring wells installed during Phase II will act as sentinels to evaluate potential future migration of produced water in the Cymric Study Area.

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1 Introduction

This hydrogeologic investigation report is submitted by Valley Waste Disposal Company (VWDC) to the California Regional Water Quality Control Board (RWQCB), Central Valley Region-Fresno Branch. The report documents the results of a drilling and monitoring well installation program and subsurface hydrogeologic characterization of the Study Area, completed by Geomega Inc. (Geomega) during August and September 2006.

1.1 Area of Investigation

The Cymric Field Study Area (approximately two square miles) is located in western Kern County, ~38 miles west of Bakersfield, CA (Figure 1). The area of this investigation is northeast of VWDC's McKittrick 1 and McKittrick 1-3 facilities (Cymric Ponds), and west of the Clean Harbors waste management facility located on Lokern Road.

1.2 Project Background

The Phase I investigation (Geomega 2004) included recommendations to better characterize the hydrogeology of the Cymric area, to determine the geochemistry of native water in the shallow zones, and to delineate the extent of the produced water in the subsurface. In a letter report to VWDC, the RWQCB (August 2004) concurred with these recommendations and requested that a work plan be developed for further subsurface investigation (Phase II). Geomega developed and submitted a work plan proposing additional investigation of the Cymric Field Study Area, as described below (Geomega 2006).

1.3 Objectives and Approach

The objectives of the Phase II borehole and monitoring well installation program were to gather hydrogeology and geochemistry data in the Cymric Field Study Area to further characterize the hydrogeologic conditions to the northeast of the Cymric Ponds (Section 19, T29S, R22E), and to determine the vertical and lateral migration of produced water downgradient from the ponds.

An approach similar to the one recommended for the Phase I investigation was proposed and approved. The recommendation included acquiring field data from three or four additional monitoring wells northeast (downgradient) from the VWDC Cymric CYM-17N1 monitoring well. Gaining access to and obtaining permits for these drilling locations was somewhat time consuming, because the Study Area is located within a sensitive wildlife habitat area.

Hydrogeologic data was gathered from the three Phase II boreholes to enhance the description of the groundwater flow system and to delineate the extent of the produced water in the subsurface, including:

- whole core intervals from borehole CYM-17K1 to define the stratigraphic column in the area;
- soil samples from boreholes CYM-17Q1 and CYM-17M1 collected while drilling with air and mud rotary;
- geophysical logs from each borehole; and
- groundwater levels, samples, and laboratory analyses for inorganic, organic, and stable oxygen/hydrogen isotopes from monitoring wells installed during the Phase I investigation (CYM-17N1, 19H1 and 21D1).

2 Drilling Program

Well CYM-17K1 was installed close to the center of Section 17, ~1.5 miles northeast of the Cymric Ponds facility. Well CYM-17Q1 was installed in the southeast corner of Section 17, ~1.4 miles northeast of the facility. CYM-17M1 was installed in the southwest corner of Section 17, ~1 mile northeast of the facility. Well locations are shown in Figure 1.

Geomega's (2006) Phase II hydrogeologic characterization work plan described the proposed drilling methods. A log of each borehole was completed in the field, based on the core samples and the cuttings discharged from the cyclone or shale-shaker. Groundwater samples were collected from existing monitoring wells (installed during Phase I) to better characterize the hydrogeology of the shallow aquifer area. Results of the drilling program are summarized in Table 1.

2.1 Borehole Drilling

The three boreholes were drilled to a total depth (TD) of 350 ft below ground surface (bgs) using air and mud rotary drilling methods. A geologic record of the subsurface was prepared for each well during drilling. Core samples and drill cuttings were collected and logged for each borehole.

2.1.1 Borehole CYM-17K1

Borehole CYM-17K1 was drilled from August 3 to 6, 2006. This hole was continuously cored to accurately resolve log-to-rock and fluid content responses as well as to correlate with other geophysical logs in the Study Area. This allowed for a more detailed and accurate description of the stratigraphy and pore fluid variations expected in the Study Area.

Core samples were retrieved from 20 to 228 ft bgs. Soil samples were collected at 10 ft intervals from 228 ft to TD and preserved in plastic bags for further description and interpretation. The borehole was drilled to TD of 350 ft bgs with mud rotary drilling methods. Geophysical logs were run in this borehole after reaching TD and conditioning the borehole.

Core samples and interpretation of geophysical logs indicate that the alluvium and top of the Upper Tulare Formation are dry, and first groundwater occurs deeper in the Tulare Formation, at ~275 ft bgs. The initial borehole was plugged and abandoned after formation evaluation was completed, and a twin shallow borehole was drilled ~10 ft south of the original location. The twin borehole was air drilled to a depth of 210 ft bgs and was completed as a dry, vadose zone, monitoring well in the equivalent zone as upgradient well CYM-17N1. Monitoring well CYM-17K1 will be used to evaluate possible future migration of produced water from the Cymric Ponds.

2.1.2 Borehole CYM-17Q1

Borehole CYM-17Q1 was drilled from August 17 to 20, 2006. This hole was air drilled to 200 ft bgs and mud drilling methods were used from 200 to 350 ft bgs (TD). Soil samples were taken at 10 ft intervals, and kept in plastic bags. The hole was conditioned after reaching TD and geophysical logs were run.

Soil samples collected while air drilling and interpretation of geophysical logs indicate that the alluvium and top of the Upper Tulare Formation are dry, and first groundwater occurs deeper in the Tulare Formation, at ~294 ft bgs. The initial borehole was plugged and abandoned and a twin, shallow borehole was drilled with air to 208 ft bgs. The twin borehole is located ~ 10 feet south of the initial borehole and was completed as a dry, vadose zone, monitoring well in the equivalent zone as upgradient well CYM-17N1. Monitoring well CYM-17Q1 will be used to evaluate possible future migration of produced water from the Cymric Ponds.

2.1.3 Borehole CYM-17M1

This borehole location was originally planned for the northwest corner of Section 17, ~1.3 miles northeast of the Cymric Ponds. However, at the request of VWDC/Geomega and the approval of the RWQCB (RWQCB 2006), the location was moved ~ 0.25 miles south of the original location to enhance delineation of the produced water mound, after evaluation and interpretation of results from the 17K1 and 17Q1 boreholes.

Borehole CYM-17M1 was drilled from August 29 to September 5, 2006. Air-drilling methods were used from the surface to 200 ft bgs, and mud rotary methods from 200 ft to 350 ft (TD). Soil samples were collected at 10 ft intervals, and preserved in plastic bags for future use. Geophysical logs were run after reaching TD and conditioning the borehole.

Similarly to previous boreholes, soil samples collected while air drilling and interpretation of geophysical logs indicate that the alluvium and top of the Upper Tulare Formation are dry, and first groundwater occurs deeper in the Tulare Formation, at ~265 ft bgs. The initial borehole was plugged and abandoned and a twin, shallow borehole was drilled with air to 198 ft bgs. The twin borehole is located ~ 10 feet west of the initial borehole and was completed as a dry, vadose zone, monitoring well in the equivalent zone as upgradient well CYM-17N1. Monitoring well CYM-17M1 will be used to evaluate possible future migration of produced water from the Cymric Ponds.

2.2 Soil Sampling

Continuous core samples were collected from borehole CYM-17K1 using a 2.5-inch (94 mm) diameter core sampler. Core samples were retrieved in 5 ft barrels via a wire line run inside the drill pipe, as drilling mud was discharged into the mud pit. Samples were washed to remove excess mud, and were described by the field geologist. Core photographs are provided in Appendix A. Borelogs were completed to document the subsurface geologic conditions present in each borehole.

Boreholes CYM-17Q1 and CYM-17M1 were drilled using a combination of air and mud rotary drilling methods, in intervals as follows:

CYM-17K1

- air drilling from 0 to 20 ft
- mud coring from 20 to 228 ft
- mud drilling from 228 to 350 ft

CYM-17Q1

- air drilling from 0 to 200 ft
- mud drilling from 200 to 350 ft

CYM-17M1

- air drilling from 0 to 200 ft
- mud drilling from 200 to 350 ft

Soil samples were collected at 10 ft intervals in each borehole, while drilling with both air and mud. These cuttings were described and preserved in plastic bags for future use.

2.3 Geophysical Logging

After each mud rotary borehole was drilled to total depth and conditioned, wireline geophysical logging tools were run to describe the physical properties of the subsurface horizons encountered at each location. Geophysical logs were run in the deeper, mud rotary boreholes, from TD to the base of the conductor casing and included electrical resistivity, bulk density, neutron porosity, gamma ray, spontaneous potential, and caliper. These logs were also used to correlate the shallow stratigraphy with geophysical logs from adjacent wells, and select the appropriate completion intervals. Copies of the geophysical logs for each borehole are included in Appendix B.

3 Monitoring Well Installation

Based on field observations and interpretation of geophysical logs that demonstrated first groundwater occurred deep in the Tulare Formation, it was recommended and approved by the RWQCB (8/20/2006 telephone call with Jim Dowdall) to plug and abandon the original boreholes and drill a shallower, twin borehole at each location. Three dry vadose zone monitoring wells were completed in the equivalent Upper Tulare Formation sands encountered and screened in the Phase I monitoring wells CYM-17N1 and CYM-19H1. As described in Section 2 of this report, air rotary drilling methods were used to install the Phase II vadose zone monitoring wells. Based on description of soil samples from each borehole and geophysical log interpretation, the dry monitoring wells were completed in the stratigraphically equivalent zone as upgradient well CYM-17N1, using 30 to 50 ft of screen (Appendix C).

3.1 Completion Methods

Each well was completed using five-inch diameter, Schedule 80, threaded polyvinyl chloride (PVC) casing with 0.020-inch factory-slotted screen. General well completion procedures are described as follows:

1. Determine desired completion interval based upon lithologic and geophysical logs.
2. Assemble 5 to 10 ft blank and end cap (sump) into borehole on factory slotted PVC screen and riser to appropriate completion depth.
3. Gravel-pack well by pumping No. 3 RMC Lapis Lustre sand from plugged-back total depth to ~5 ft above the top of the well screen.
4. Pump ~5 ft of bentonite seal above the gravel pack.
5. Cement annulus from top of bentonite seal to ground surface with a mixture of Type II/V cement and bentonite in 100 ft lift intervals to ensure the PVC did not collapse or melt. Lifts were cured for sufficient time to gain compressive strength to support subsequent lifts.
6. Pull out conductor casing and cut PVC casing stick-up to ~3 ft above ground surface.
7. Install steel monument cover with lock over PVC stub and burn well number in top plate with welder.

8. Pour concrete apron with four-corner traffic guard around well monument.
9. Survey well location, ground surface elevation, and top of casing elevation.

California State accepted procedures were followed during well construction and development (CalEPA 1995a). Well permits and survey plots for each well can be found in Appendix D.

3.2 Monitoring Well Development

Since none of the Phase II monitoring wells encountered groundwater, they were not developed using typical methods for groundwater wells. The dry wells were set and evacuated with low pressure air lift.

3.3 Groundwater Sampling

Groundwater samples were collected from each of the Phase I monitoring wells using California State accepted groundwater sampling procedures (CalEPA 1995b; Appendix C). Each sample was labeled to document the sample location, date, time, and collector. Samples were retained on ice in an insulated container. Chain-of-custody records were prepared in the field and accompanied the samples to Test America (general chemistry) and Zymax Laboratories (stable isotopes); both are State-certified laboratories. All samples were received at their respective labs, intact, at or below 4°C.

A sample from each well was submitted for analysis of general chemistry, including metals, total dissolved solids (TDS) and boron. In addition, the samples were analyzed for the presence of aromatic hydrocarbons, benzene, toluene, ethylbenzene, and xylene (BTEX). Stable oxygen and hydrogen isotopic compositions of the three monitoring wells were also tested. Appendix E contains the complete record of groundwater sample analyses conducted for CYM-17N1, CYM-19H1, and CYM-21D1 along with copies of the chain-of-custody papers.

4 Hydrogeology

4.1 Regional Hydrogeologic Setting

The Cymric Field Study Area is located in the southwestern San Joaquin Valley, just east of the Cymric Oil Field and the Temblor Hills. This is an area of intense and recent structural disturbance due to range-front thrusting and strike-slip movement in relation to the San Andreas Fault zone. Compressive tectonic forces along this zone have formed subsurface anticlinal structures and deeply rooted normal and reverse faults along the southwestern margin of the San Joaquin basin, which is filled with thick, relatively young, sedimentary deposits. The San Joaquin Valley is a north-south trending basin residing between the Temblor Range of the Franciscan complex to the west and the Sierra batholith to the east. The west side of this basin has been filled with marine-derived sediments originating from the nearby Temblor and Coastal ranges, forming shallow horizons dipping to the east toward the axis of the San Joaquin basin.

The structural and stratigraphic development of geologic formations along the southwestern margin of the San Joaquin Valley from the Plio-Pleistocene age through the present (Tulare Formation and alluvium) has resulted in a unique and complex hydrogeologic environment. The southern San Joaquin Valley, east of the Coastal Range and Temblor Hills, represents a transitional area between the large, regional hydrogeological system of the central San Joaquin Valley and the localized groundwater sources that occur along the uplifted western margin of this intermontane basin. The convergence of different depositional systems in this area creates a complex environment of interfingered sedimentary layers, which results in hydraulic conductivity variations and vertical barriers (aquitards) within the groundwater basin, as well as geochemical changes caused by separate water sources and rock/water interaction.

Holocene deposits of the southwestern San Joaquin Valley consist of alluvial fans derived from the Coastal Range, while the central and eastern valley deposits are alluvial fan and lacustrine, sourced from the Sierra batholith. Groundwater on the west side of the San Joaquin Valley is sulfate-enriched, with TDS typically between 3,000 and 6,000 ppm. These

host soils were derived from Coastal Range marine rocks, which contained saline connate water. Resulting valley-fill alluvial fan deposits are alkaline-rich, arid soil horizons, incapable of forming freshwater aquifers.

4.2 Local Hydrogeologic Setting

In general within the Cymric area, the stratigraphic depositional environment consists of uplifted arid alluvial fan systems underlain by the regional Corcoran Clay Equivalent (CCE) and lacustrine sands. Figure 2 is a type log and stratigraphic section representing the hydrogeology interpretation near the Cymric Pond Facility. The alluvial fan systems form where high-gradient streams, carrying detritus from the Coastal Range west of the Cymric area, enter the relatively flat San Joaquin Valley floor near the Cymric Field Study Area. A thick silty-clay section is found at the base of the alluvial fan sequences and is indicative of an alluvial plain to lacustrine depositional environment transition. Lacustrine deposits occur near the base of the Holocene section in the Cymric Field Study Area. A shoreline sheet sand that represents the last regressive sequence of the paleo-San Joaquin embayment is encountered on top of the CCE within the Study Area. The CCE appears as an inorganic silty clay, to silt, which separates the Holocene alluvium from the Pleistocene Tulare hydrostratigraphic unit.

There is no evidence of groundwater in the thinner, alluvial fan units in the Study Area. The native aquifer in the Cymric area is groundwater in the deeper Tulare Formation. Meteoric water entering the groundwater basin in this area is typically limited in supply and more mineralized as a result of infiltration through arid and marine-derived sediments.

4.2.1 Alluvial Sediments

Unconsolidated Holocene alluvial plain sediments are encountered across the Cymric area at the ground surface. This package of sediments consists of a series of alluvial fan sequences sourced in the Temblor Hills and Elk Hills, which prograded eastward toward the axis of the San Joaquin Valley. Based on core description from CYM-17K1 and correlation of geophysical logs, the alluvium is present from ground surface to depths of less than 85 ft bgs in the Cymric Study Area (Table 2). Soil types in this horizon are characterized by silty sands

to sand layers interbedded with variably thick lenses of stiff clay to silty clay. Silty sand layers are composed of yellowish brown, very fine to medium, subangular to rounded sand grains, generally well sorted. Interbeds of tan to yellowish brown, soft to very stiff silty clays occur between the sandy layers. Lenses of poorly sorted, angular to subangular gravelly sands occasionally occur in the interbedded sequence.

4.2.2 Corcoran Clay Equivalent

The CCE is thinner and appears to have gone through a facies change within the Cymric Study Area compared to what is typically observed in the western San Joaquin Valley. For example, at the South Belridge Field ~ 1.5 miles northwest of the Cymric Study Area, the CCE is present as a pervasive, thick, stiff, organic-rich clay. It appears to be a more permeable silty clay unit in the Cymric area, since it is not acting as a vertical hydraulic barrier beneath the Cymric Ponds, as evident by the presence of produced water in Upper Tulare Formation sands. On the basis of field data available in this region of the San Joaquin Valley, the CCE is encountered approximately 50 feet higher in the subsurface at Cymric than at South Belridge. The vertical variation of the CCE over a relatively short lateral distance is caused by abrupt structural uplift at depth beneath the Cymric area. Stratigraphic heterogeneities present in the CCE over this short lateral distance are controlled by the structural setting of the region.

Typically, the CCE is a widespread lacustrine clay package that demarcates the transition from Holocene alluvium to Pleistocene Tulare deposition. It is stratigraphically positioned just below a lacustrine sheet sand and above the underlying upper Tulare Formation. It is typically an olive gray, stiff to hard, highly plastic, organic-rich clay to silty clay, containing minor amounts of dark mottling. The CCE is usually a hydraulic barrier to flow, due to its lithology and pervasive nature.

4.2.3 Upper Tulare Formation

The Upper Tulare water-bearing sands are encountered at a depth of ~ 250 to 294 ft bgs in the Cymric Study Area. Depositional environments of the Upper Tulare Formation appear to vary significantly across the Study Area from lacustrine delta to meandering stream, point

bar facies as a result of a Tulare Lake regressional sequence. This sand sequence thickens toward the eastern part of the Study Area, thinning westward, and pinching out into silt and clay near the Temblor Range.

The sand sequence is characterized by a light gray, fine to very fine, subrounded, loose silty-sand to sand, appearing well sorted in places with minor lenses of fat clays. Occasional layers of fine platy mica-rich sand were encountered within this sand sequence. According to core photographs, upper Tulare sands are first encountered in CYM-17K1 at 120 ft (Appendix A). Table 2 summarizes locations and elevations.

4.3 Groundwater Occurrence

On the basis of the Phase II air rotary drilling, well testing, and geophysical log interpretation, native groundwater first occurs deeper in the Tulare Formation. According to interpretation of the geophysical logs, an air/water contact occurs at ~275 ft in CYM-17K1, at ~294 ft in CYM-17Q1, and at ~265 ft in CYM-17M1. Produced water originating in the Cymric Ponds was not encountered in the Phase II boreholes in Upper Tulare sands that were found to be saturated in the Phase I investigation. Mounded produced water in the Upper Tulare Formation sands has not migrated to the Phase II borehole locations (Figure 3).

Groundwater encountered in CYM-21D1 is apparently native groundwater occurring in the deeper Tulare aquifer, rather than produced water from the VWDC Cymric facility. This interpretation is supported by measured water level differences; 145 ft msl in CYM-21D1 vs. ~337 ft msl (285 vs ~125 ft bgs) in the other two Phase I monitoring wells, and water quality differences; ~3,000 mg/L TDS in CYM-21D1 vs. > 10,000 mg/L TDS in CYM-17N1 and CYM-19H1 monitoring wells.

Groundwater levels were measured as part of this Phase II study in monitoring wells installed during the Phase I study. Groundwater was detected at approximately 122 and 128 ft. bgs. in monitoring wells CYM-19H1 and CYM-17N1, respectively. In well CYM-21D1, groundwater was detected at 285 ft. bgs., which is approximately 160 feet deeper than measured the other wells (Table 3). Groundwater levels did not differ significantly since the last sampling of November 2002. A perched water elevation map is included as Figure 4. It

appears that produced water originating in the Cymric Ponds is flowing towards the northeast in formerly dry Upper Tulare Formation sands, based on water level measurements in the CYM-17N1 and CYM-19H1 monitoring wells and knowing that CYM-17K1, CYM-17Q1, and CYM-17M1 are dry in the stratigraphically equivalent zone.

5 Groundwater Chemistry

The Phase II investigation involved resampling existing Phase I monitoring wells CYM-19H1, CYM-17N1, and CYM-21D1 to track groundwater movement in the Study Area (Appendix C). As in Phase I, the water was analyzed for general mineral constituents, petroleum hydrocarbons, and stable isotopes of oxygen and hydrogen. Native groundwater in this area of the southwestern San Joaquin Valley is known to be brackish in nature (Davis and Coplen 1989).

5.1 Inorganic Chemistry Analysis

According to the Phase I findings, the principal ions that occur in produced water are Na and Cl, while those in native groundwater are typically Mg/Ca and SO₄.

A Stiff diagram (Figure 5) was prepared to compare the 2002 and 2006 sampling events at the three Phase I wells. Concentrations of all the major anions and cations have increased. Very high chloride, sodium and TDS concentrations were detected in the pond water and monitoring wells CYM-17N1 and CYM-19D1. Native groundwater is enriched in sulfate and calcium and/or magnesium ions, as compared to chloride and sodium. As shown on the Stiff diagram, pond water, CYM-17N1, and CYM-19H1 groundwater are enriched in chloride and sodium with respect to sulfate and calcium/magnesium, while the opposite is true for water samples from well CYM-21D1 (see values in Table 4).

An approximate chloride isoconcentration map, based on the detections of produced water in monitoring wells CYM-17N1 and CYM-19H1 and the dry Phase II boreholes/wells is included in Figure 6.

TDS is elevated in the pond cells, CYM-17N1, and CYM-19H1 samples, while CYM-21D1 samples appears to represent native groundwater quality for the Cymric Study Area. TDS concentrations analyzed in the laboratory during the Phase II investigation were 14,000 mg/L for pond water; 10,000 mg/L for CYM-17N1; 13,000 mg/L for CYM-19H1; and 3,200 mg/L for CYM-21D1 (Table 4). An approximate TDS isoconcentration map demarcates the lateral extent of elevated TDS values (Figure 7).

General inorganic water chemistry results are summarized in Table 4. Copies of laboratory analytical data and chain-of-custody forms are included in Appendix E.

5.2 Groundwater Monitoring via Stable Isotopes Ratios

In the Cymric Field Study Area, brackish produced water is disposed into surface percolation/evaporation ponds. This water infiltrates into the vadose zone where it is stored and bound in dry sediments of the alluvium and Upper Tulare Formation. Although native waters are also brackish, they contain significantly different ion chemistries, and O and H isotope abundances that vary little over time. Produced waters have isotope abundances that are both variable and distinctly different from native groundwater.

O and H isotopes behave conservatively in groundwater, and therefore allow for the use of isotopic signatures to monitor the movement of produced water through groundwater systems. Isotopes represent the water as it migrates, but not ions or dissolved solids, whose movement through soil may be attenuated or amplified. Stable isotopes of O and H are reported as per millage change of O^{18} and H^2 (or deuterium, D) from standard mean oceanic water (SMOW), or $\delta^{18}O$ and δD , respectively.

On a bilinear diagram of oxygen and hydrogen isotopic compositions collected during the September 2006 sampling event, the isotopic signature of water from the Cymric Ponds and Phase I monitoring wells has shifted to the right compared to the 2002 event. As observed in Figure 8, wells CYM-17N1 and CYM-19H1 plot far to the right and closer to pond water, which implies that water quality from these wells is similar to produced water. Even though monitoring well CYM-21D1 results had shifted to the right, the composition is more similar to the isotopic composition of meteoric water, which indicates that this well represents native

quality water. Oxygen and hydrogen isotopic analytical data for water samples are summarized in Table 5.

5.3 Organic Geochemistry Data

All three Phase I wells were resampled and analyzed as part of the Phase II investigation for the presence of aromatic petroleum hydrocarbons: benzene, toluene, ethylbenzene, and xylene (BTEX) (Table 6). Similar to the 2002 sampling event, all three wells reported non-detects of BTEX. However, the Cymric Ponds analyzed 5.7 µg/L of ethylbenzene compared to none detected in 2003. Related results were observed for benzene and toluene, which were two orders of magnitude higher than previous analyses. The samples were not analyzed for total petroleum hydrocarbons (TPH).

6 Summary and Conclusions

VWDC installed three monitoring wells (CYM-17K1, CYM-17Q1, and CYM-17M1) during August and September 2006, as part of the Phase II hydrogeologic investigation of the Cymric Study Area. This field program has characterized the lateral and vertical extent of produced water migration down-gradient from the Cymric Ponds. As part of the Phase II field program, three boreholes were drilled to obtain geophysical and soil boring logs, three Upper Tulare Formation vadose zone monitoring wells were installed (stratigraphic equivalent to completion zone of upgradient well CYM-17N1), and groundwater level/quality data were collected from the Phase I monitoring wells.

Water was not encountered in the alluvium or Upper Tulare Formation sands in the three Phase II boreholes, but native groundwater was detected deeper in the Tulare Formation in these boreholes, based on geophysical log interpretation. After the initial boreholes were evaluated and abandoned, twin holes were drilled to the base of the upper Tulare sands with air rotary methods, and the boreholes were completed as vadose zone monitoring wells. These dry monitoring wells were completed in the equivalent sands being monitored in two of the upgradient Phase I wells (CYM-17N1 and CYM-19H1). Produced water in the Upper Tulare Formation sands is not present at the Phase II well locations.

A hydrogeologic cross section (Figure 3) illustrates the vertical and lateral extent of the produced water mound. It shows that the produced water is perched on a clay horizon in the Upper Tulare Formation and has migrated less than 1 mile from the Cymric pond facility.

Water samples from the monitoring wells installed during the Phase I investigation were collected and analyzed for stable oxygen and hydrogen isotopes, aromatic hydrocarbon derivatives, and general inorganic mineral constituents to track of groundwater conditions. Analytical results from the 2006 sampling event verify Phase I findings. Monitoring wells CYM-17N1 and CYM-19H1 tend toward Cl and Na composition, and have laboratory analyzed TDS values ~10,000 ppm higher than well CYM-21D1. These results indicate that water encountered in wells CYM-17N1 and CYM-19H1 display constituents of produced water, while water encountered in monitoring well CYM-21D1 is indicative of native Tulare

Formation groundwater. Stable O/H isotopes data also confirm that water sampled from monitoring wells CYM-17N1 and CYM-19H1 is similar to produced water, while water sampled from well CYM-21D1 has a composition more similar to meteoric water.

Additionally, the static water levels measured in CYM-17N1 and CYM-19H1 show that the produced water is perched approximately 160 feet above the native Tulare water table observed in CYM-21D1.

Monitoring wells CYM-17K1, CYM-17Q1, and CYM-17M1 were added to the network during Phase II, as sentinels for monitoring possible future migration of produced water in dry Upper Tulare Formation sands.

7 References

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- RWQCB 2006. Email from Jim Dowdall to Jeff Anderson, Subject VWDC Cymric PII Field Program - Move 17E to 17M, 4:40P MDT, August 25, 2006.

TABLES

Table 1. Well summary.

Well ID	Dates Drilled	Surveyed Surface Elevation (ft amsl)	Total Drill Depth (ft bgs)	Dates Installed	5" PVC Casing Elevation (ft amsl)	Steel Casing Elevation (ft amsl)	Screened Interval (ft bgs)	Well Construction Material
Phase II Study Results								
CYM-17K1	8/03/06 to 8/06/06	427.9	350	8/09/06 to 8/16/06	430.9	431.9	150 to 200	5-inch Sch 80 PVC 0.020 slot screen
CYM-17M1	8/29/06 to 9/05/06	446.5	350	9/06/06 to 9/08/06	449.5	450.5	155 to 185	5-inch Sch 80 PVC 0.020 slot screen
CYM-17Q1	8/17/06 to 8/20/06	437.6	350	8/21/06 to 8/23/06	440.6	441.6	160 to 200	5-inch Sch 80 PVC 0.020 slot screen
Phase I Study Results								
CYM-17N1	11/19/02 to 11/22/02	451.5	240	11/19/02 to 11/22/02	449.5	450.5	105 to 165	5-inch Sch 80 PVC 0.020 slot screen
CYM-19H1	11/06/02 to 11/09/02	469.2	245	11/06/02 to 11/09/02	471.2	472.2	115 to 155	5-inch Sch 80 PVC 0.020 slot screen
CYM-21D1	11/11/02 to 11/19/02	427.1	300	11/11/02 to 11/19/02	429.1	430.1	274 to 294	5-inch Sch 80 PVC 0.020 slot screen

amsl - above mean sea level

bgs - below ground surface

Table 2. Well locations, top of CCE and Tulare Formation elevations.

Well ID	Coordinates		Measuring Point Elevation (ft amsl)	Top of CCE Depth (ft bgs)	Top Tulare Formation Depth (ft bgs)	Top Tulare Formation Elevation (ft amsl)
	Easting	Northing				
CYM-17K1	1513387.3647	696298.9085	427.9	82.0	113.6	314.3
CYM-17M1	1511084.5568	696235.5985	446.5	85.0	106.8	339.7
CYM-17N1	1511328.2000	694790.4000	451.5	85.0	113.0	338.5
CYM-17Q1	1514439.9498	694727.9350	437.6	80.0	118.0	319.6
CYM-19H1	1510550.4000	692967.5000	469.2	93.0	112.0	357.2
CYM-21D1	1516237.9000	694328.6000	427.1	80.0	122.5	304.6

Coordinates in California State Plane, Zone 5, NAD 27

Table 3. Water level data.

Well ID	Measurement Datum, 5" PVC Casing (ft amsl)	Depth to Water (ft bgs)	Water Elevation (ft bgs)
Phase II Study Results (2006)			
CYM-17N1 9/6/2006	449.5	128.2	321.3
CYM-19H1 9/6/2006	471.2	121.9	349.3
CYM-21D1 9/6/2006	429.1	285.3	143.8
Phase I Study Results (2004)			
CYM-17N1 11/26/2002	449.5	140.0	309.5
CYM-19H1 11/26/2002	471.2	129.0	342.2
CYM-21D1 11/26/2002	429.1	285.0	144.1

amsl - above mean sea level

bgs - below ground surface

Table 4. Inorganic analytical data.

Analyte	Cymric Pond 9/6/2006	Cymric Pond 1/14/2003	CYM-17N1 9/6/2006	CYM-17N1 11/25/2002	CYM-19H1 9/6/2006	CYM-19H1 11/26/2002	CYM-21D1 9/6/2006	CYM-21D1 11/24/2002
Boron	67	54	24	20	39	36	10	2.5
Calcium	190	120	810	810	960	760	260	100
Chloride	8100	4520	3500	2700	4900	4120	600	334
Specific Conductance	28000	14600	14000	10900	17000	15600	4400	1970
Magnesium	75	66	230	330	380	260	180	88
Nitrate-N	ND	ND	30	9	16	22	0.23	0.85
Potassium	110	55	5.2	8	9.4	12	3.0	2.1
Sodium	5200	2900	2000	1300	2500	2500	520	170
Sulfate	250	170	2200	2090	2400	2420	1600	423
Total Dissolved Solids	14000	8500	10000	7450	13000	10500	3200	1200
Alkalinity as CaCO ₃	800	570	250	3360	420	2990	130	624
Bicarbonate Alkalinity as CaCO ₃	800	1500	250	400	420	600	130	140
Carbonate Alkalinity as CaCO ₃	ND	ND	ND	ND	ND	ND	ND	ND
Hydroxide Alkalinity as CaCO ₃	ND	ND	ND	ND	ND	ND	ND	ND

All units mg/L; except specific conductance (µmhos/cm)

ND - nondetect

Table 5. Oxygen and hydrogen isotopic compositions of water samples.

Analyte	Phase II Study Results				Phase I Study Results			
	Cymric Pond 9/6/2006	CYM-17N1 9/6/2006	CYM-19H1 9/6/2006	CYM-21D1 9/6/2006	Cymric Pond 1/14/2003	CYM-17N1 11/25/2002	CYM-19H1 11/26/2002	CYM-21D1 11/24/2002
δO^{18}	-4.4	-4.5	-4.0	-8.5	-5.1	-6.0	-4.5	-11.6
δD	-47	-51	-47	-68	-60	-65	-55	-93

All units reported as per millage change

Table 6. Organic analytical data.

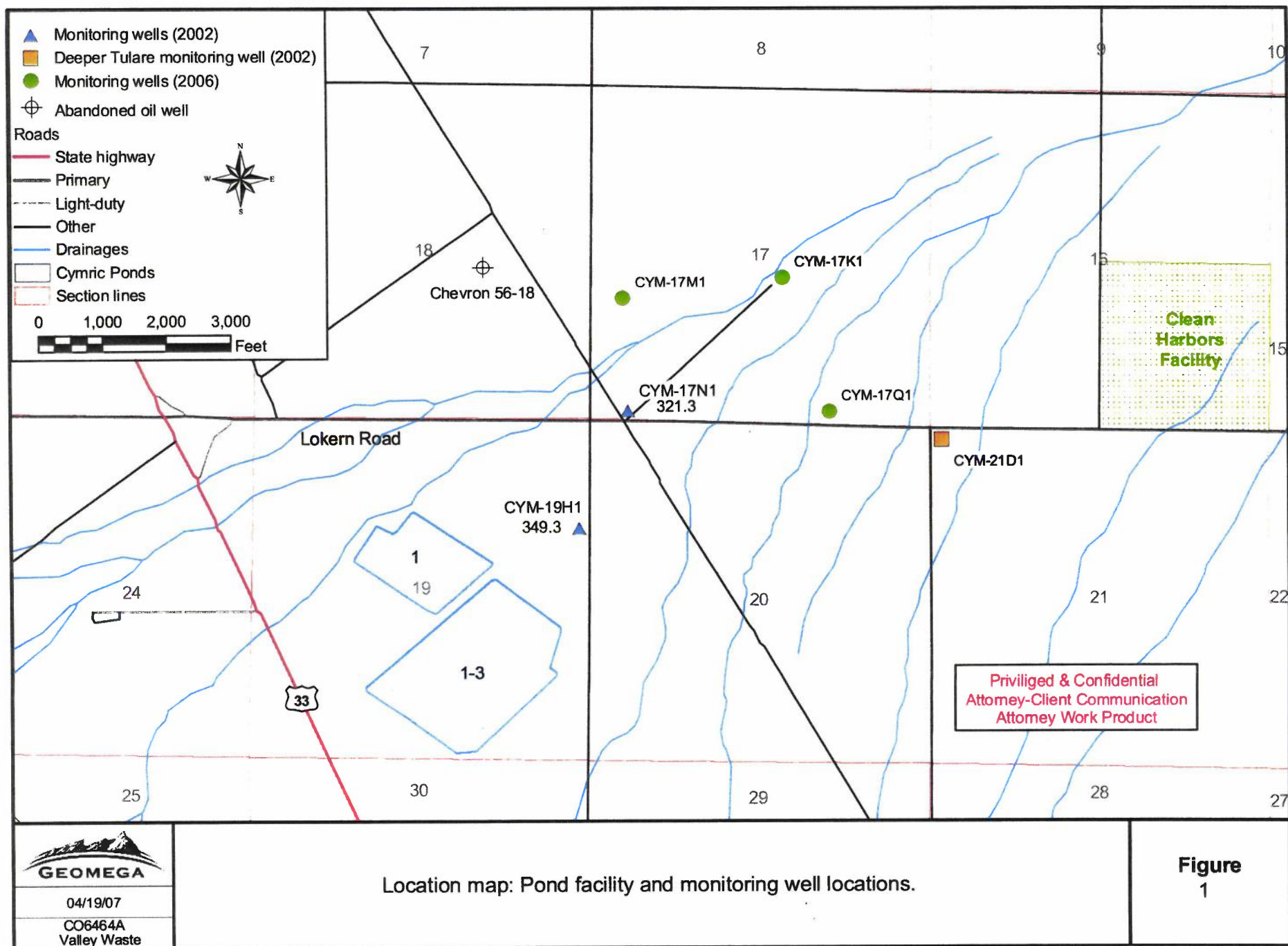
Analyte	Phase II Study Results				Phase I Study Results			
	Cymric Pond 9/6/2006	CYM-17N1 9/6/2006	CYM-19H1 9/6/2006	CYM-21D1 9/6/2006	Cymric Pond 1/14/2003	CYM-17N1 11/25/2002	CYM-19H1 11/26/2002	CYM-21D1 11/24/2002
TPH Crude Oil	NA	NA	NA	NA	3.8	ND	3.9	ND
Benzene	39	ND	ND	ND	0.6	ND	ND	ND
Ethylbenzene	5.7	ND	ND	ND	ND	ND	ND	ND
m, p-Xylenes	21	ND	ND	ND	NA	NA	NA	NA
o-Xylene	11	ND	ND	ND	NA	NA	NA	NA
Total Xylenes	NA	NA	NA	NA	2.6	ND	ND	ND
Toluene	56	ND	ND	ND	0.31	ND	ND	ND

All units µg/L, except TPH crude oil (mg/L)

ND - nondetect

NA - not analyzed

FIGURES

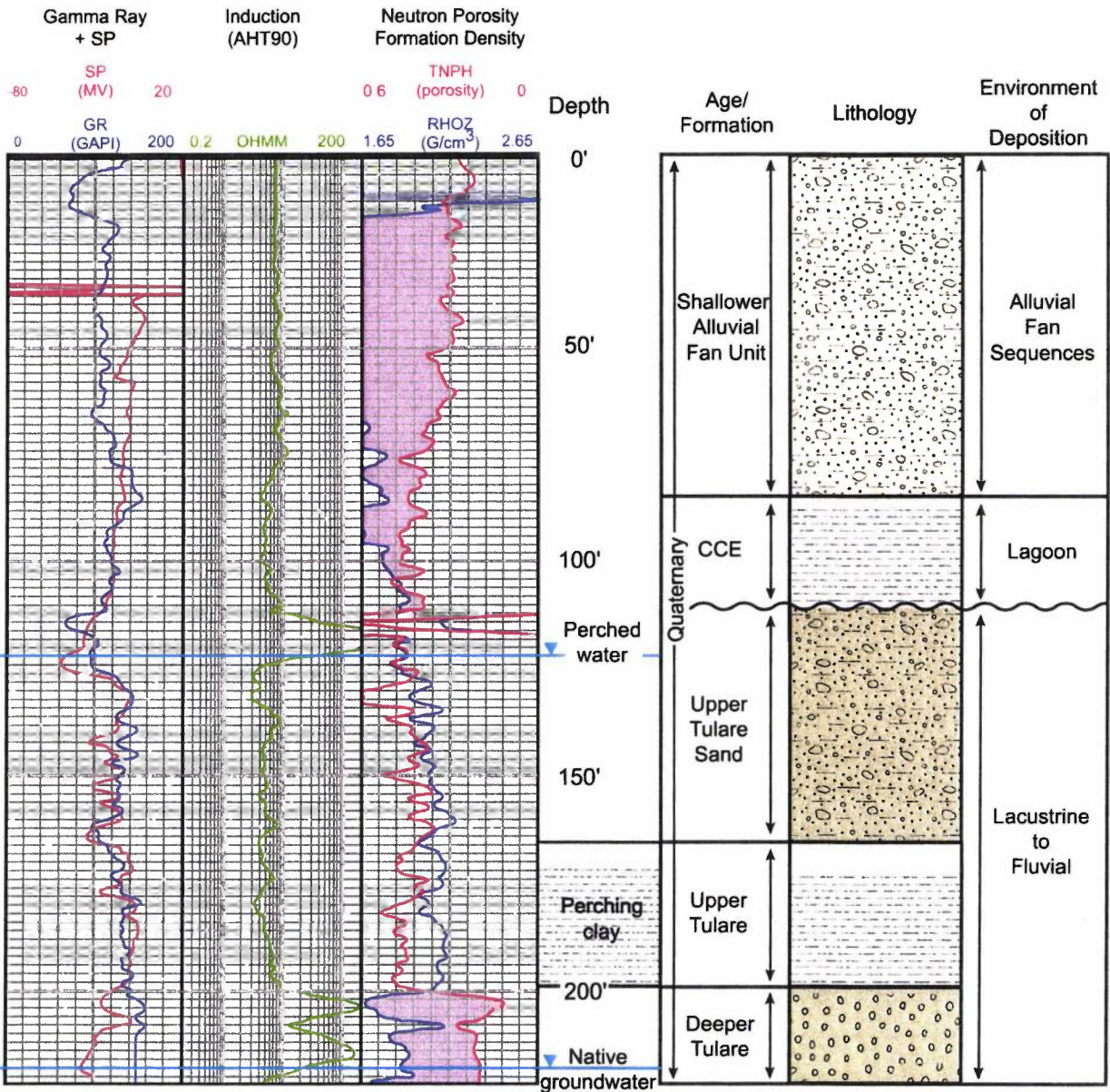


Location map: Pond facility and monitoring well locations.

Figure
1

Geophysical Type Log

Stratigraphic Section



Privileged and Confidential
Attorney-Client Communication
Attorney Work Product

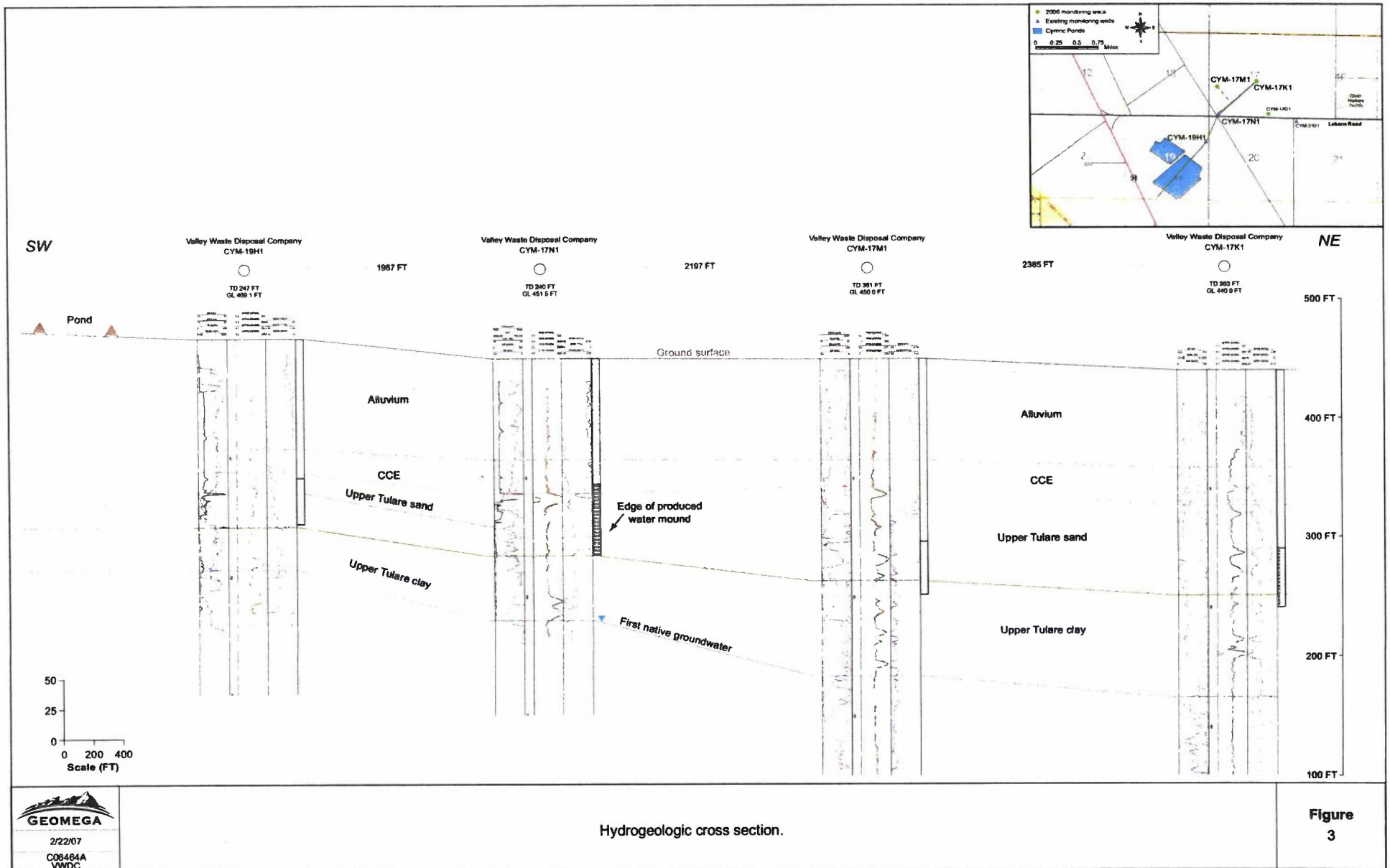


4/19/07

C06464A
VWDC

Typical log and stratigraphic section in Cymric area.

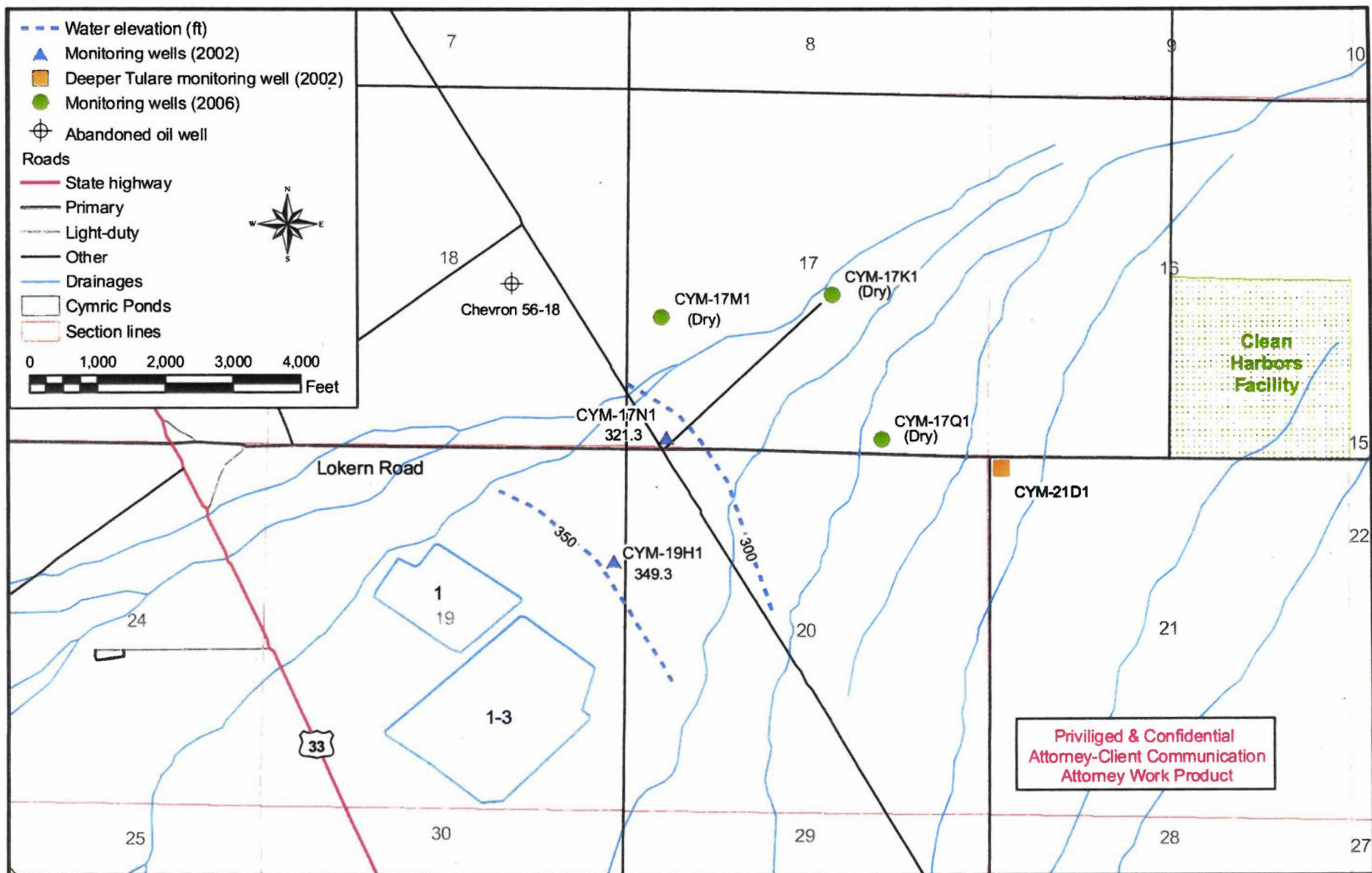
Figure
2



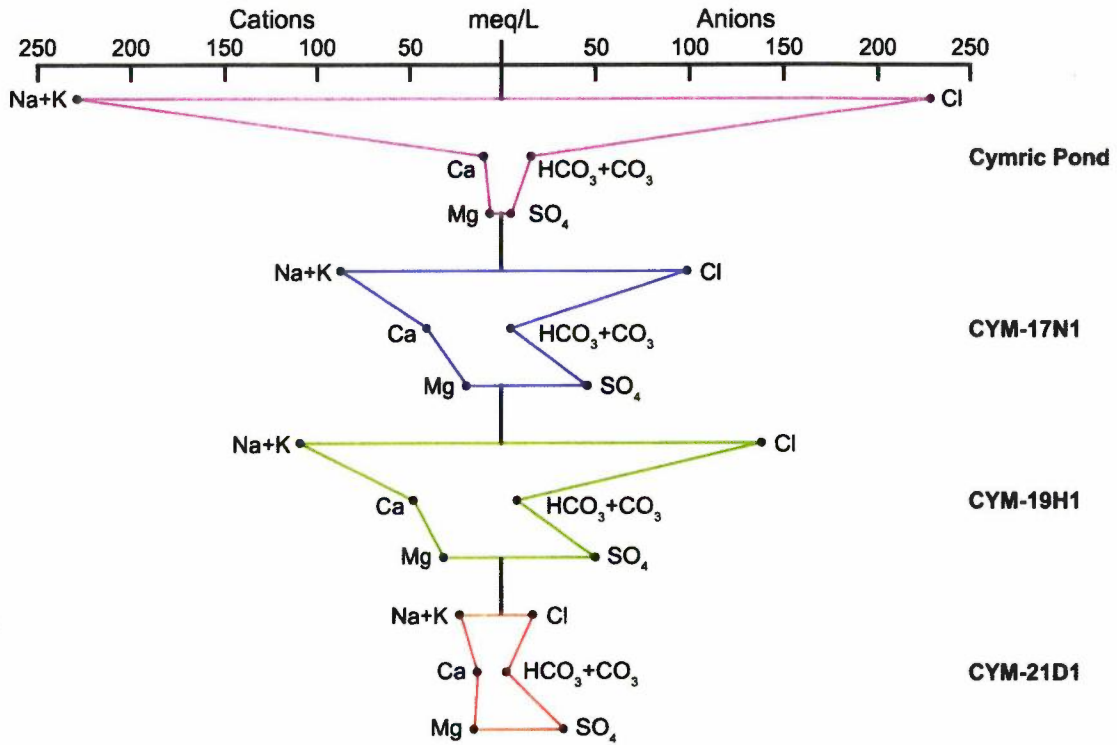
Hydrogeologic cross section.



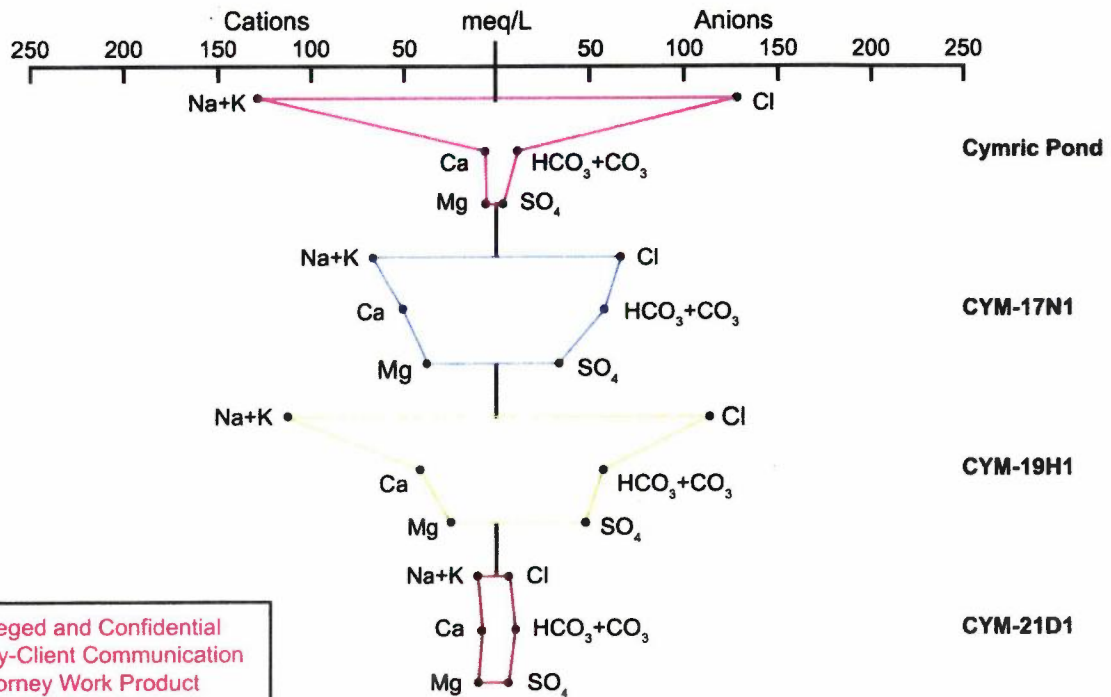
2/22/07
C08464A
VWDC



September 2006



November 2002 and January 2003



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Attorney-Client Communication
Attorney Work Product

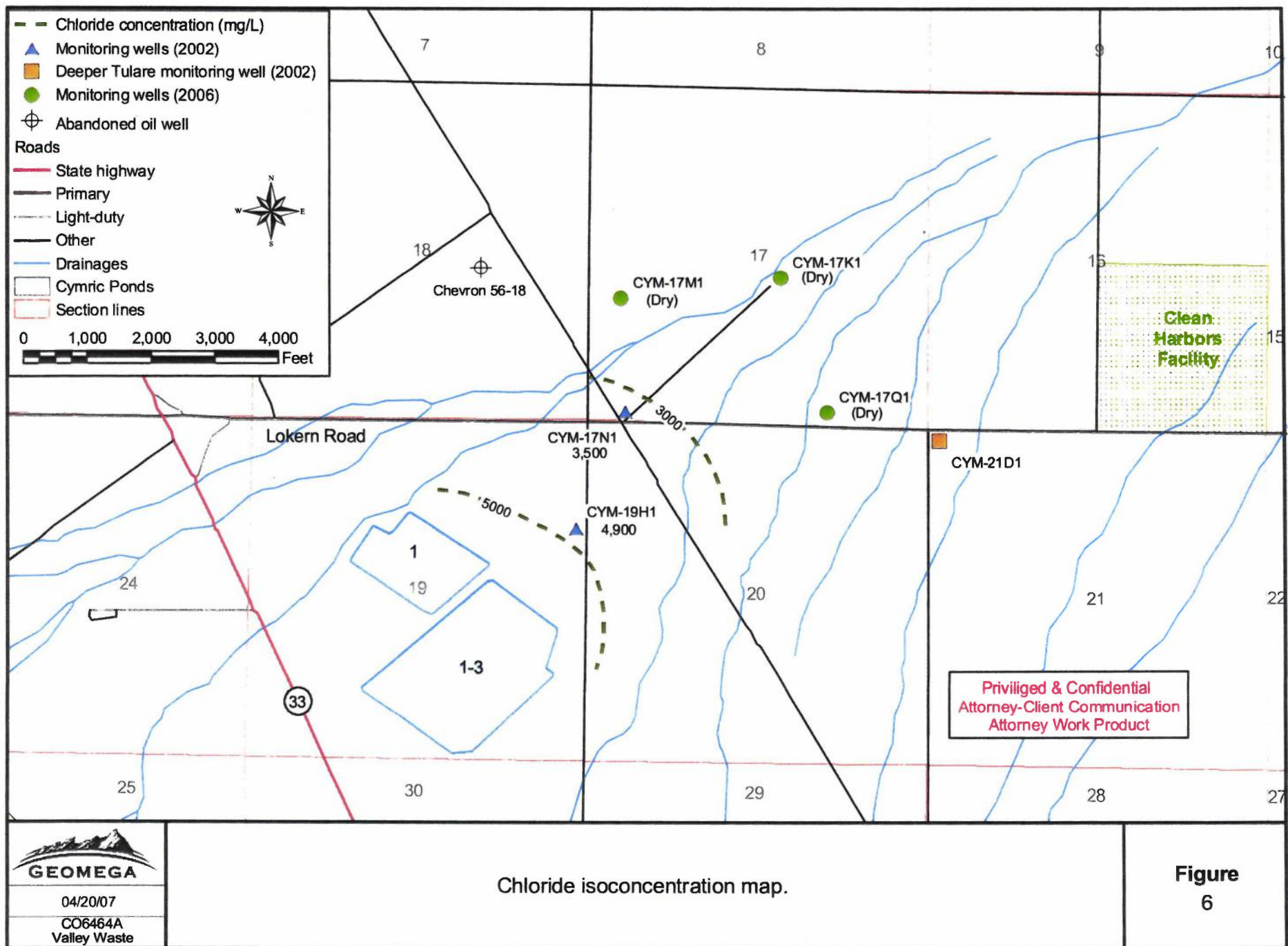


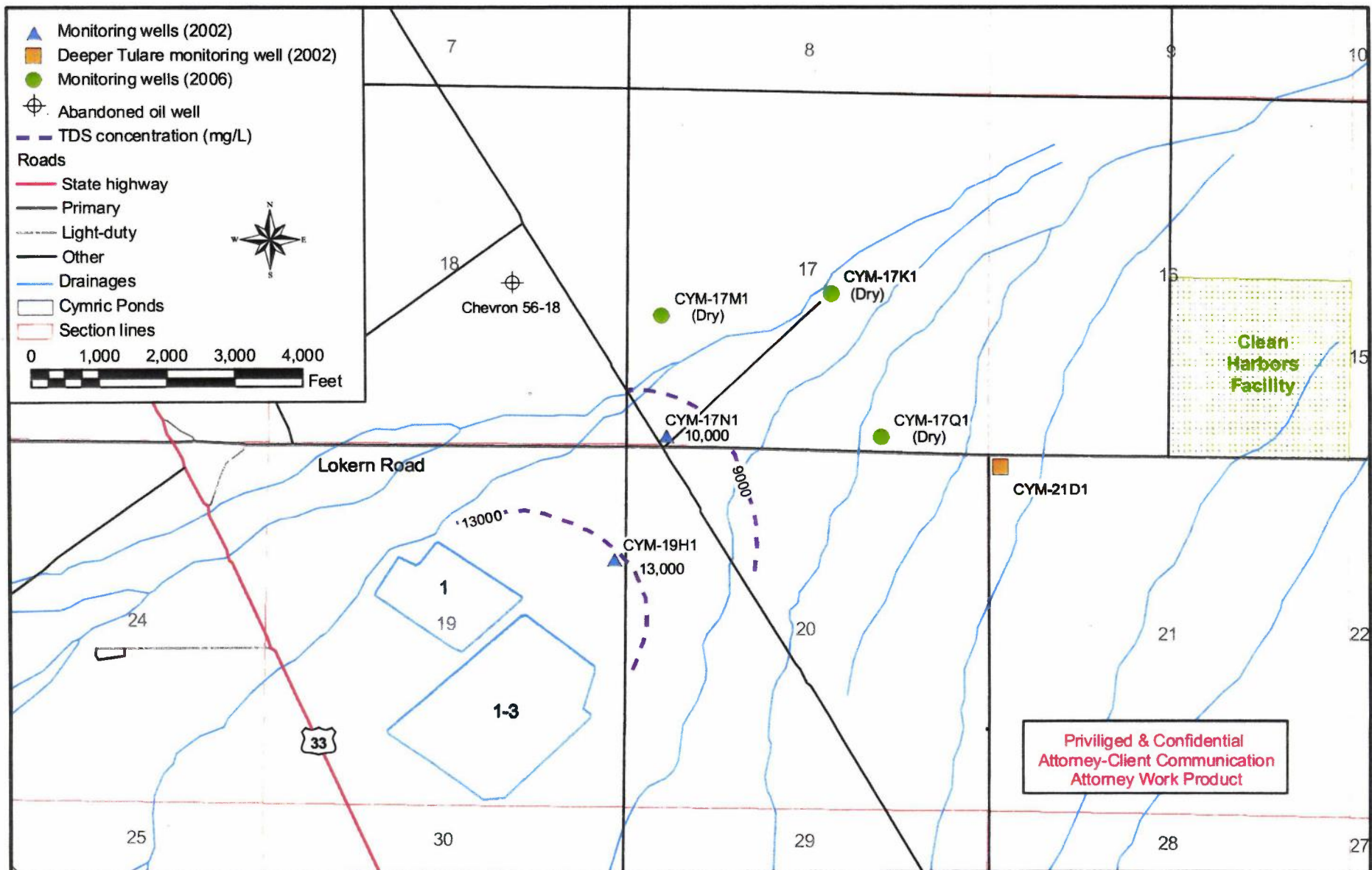
4/20/07

C06464a
VWDC

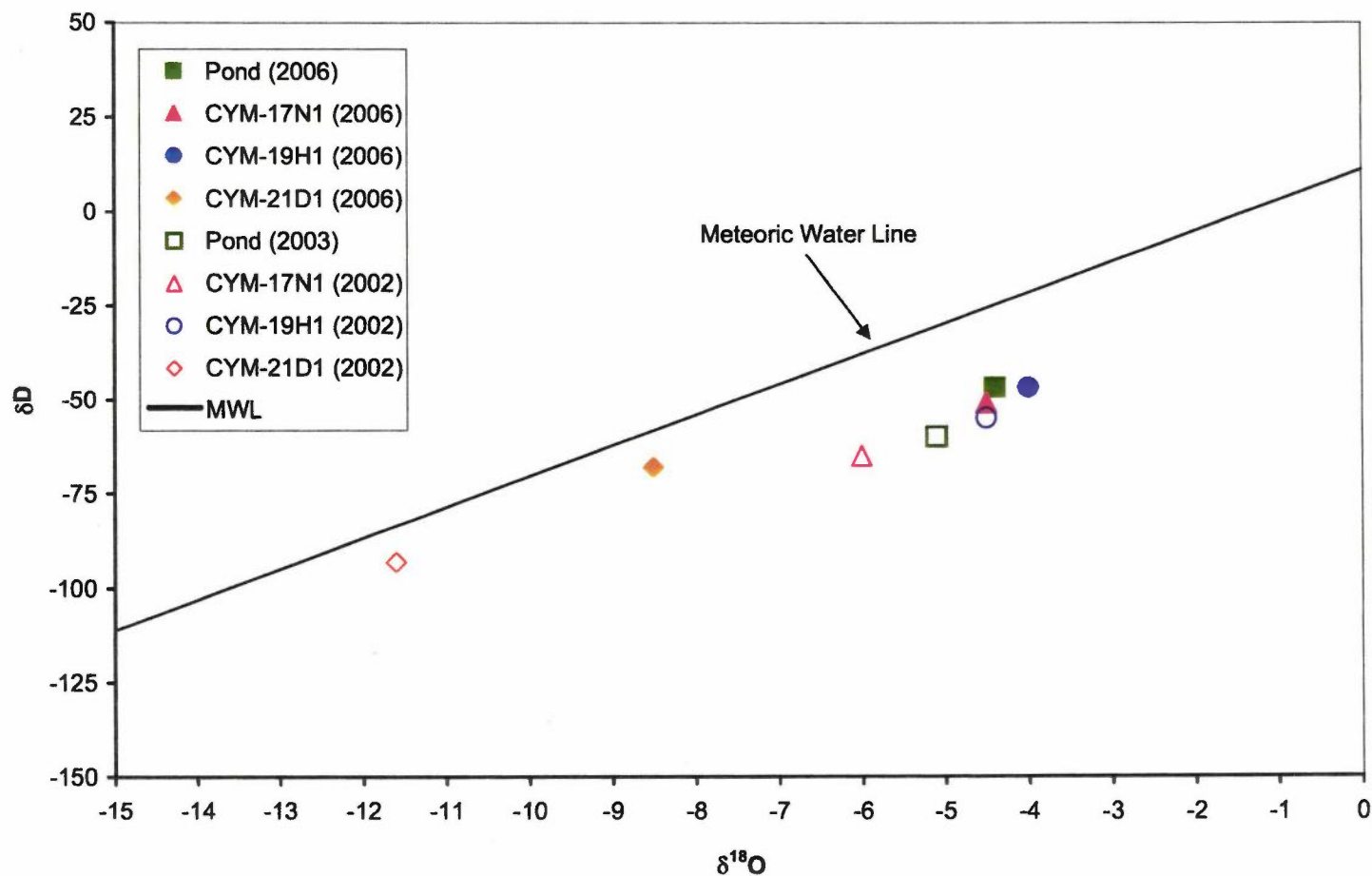
Stiff diagram of water samples.

Figure
5





TDS isoconcentration map.



4/19/07

C06464A
VWDC

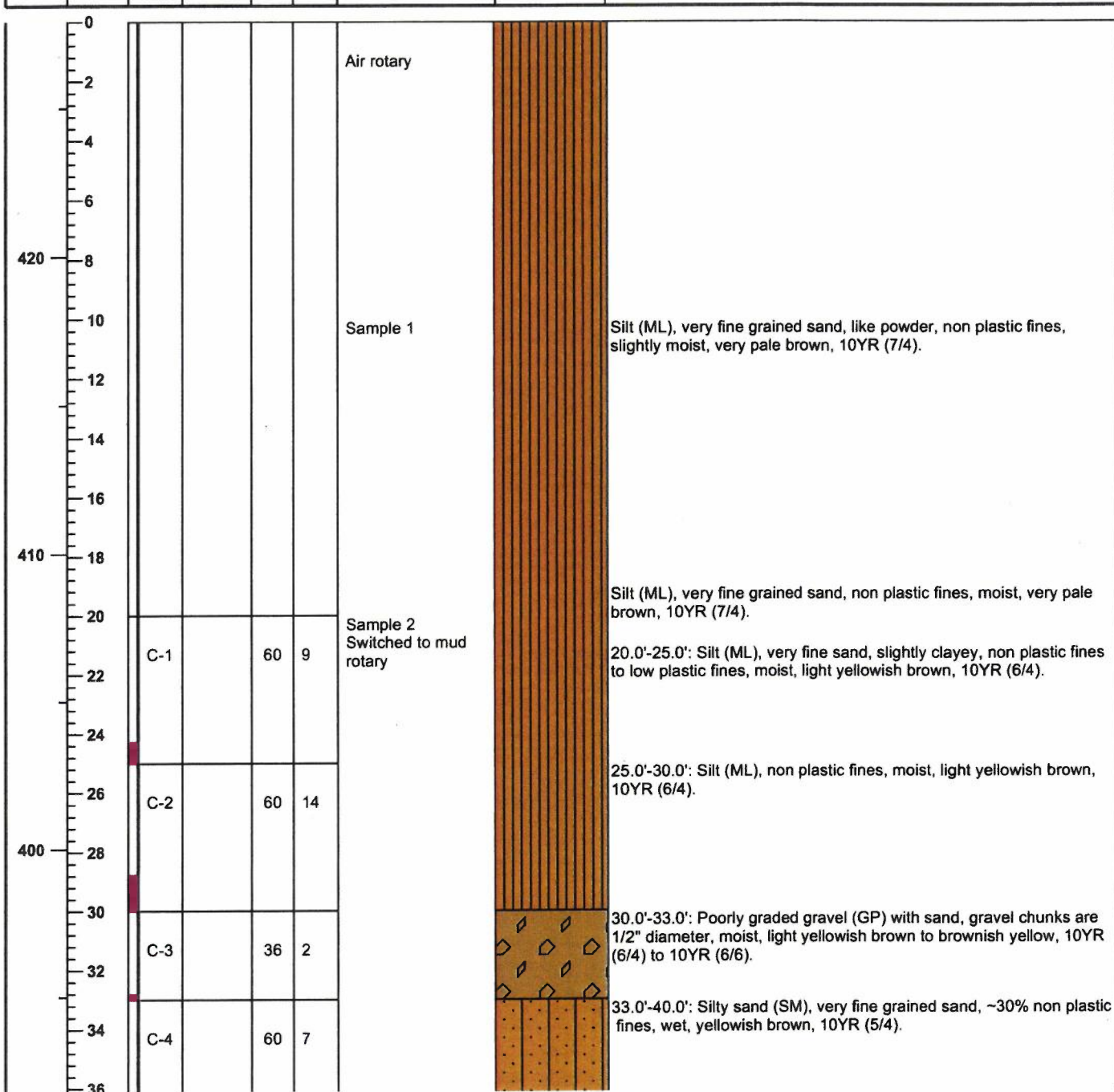
Oxygen and hydrogen isotopic composition

Figure
8

APPENDIX A

SEE ZIP FILE OF PHOTOS

APPENDIX B



NOTES: 1) Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment.
2) The well was drilled using air and mud rotary drilling techniques.
3) Cored using a 94mm wireline and mud rotary methods.

PROJECT NAME
VALLEY WASTE - PHASE II
PROJECT NUMBER
CO6464A




S = SPLIT SPOON SAMPLE

U = UNDISTURBED SAMPLE

 = GROUNDWATER

EL.	DEPTH	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
FT.	FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			

<p>NOTES: 1)Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment. 2)The well was drilled using air and mud rotary drilling techniques. 3)Cored using a 94mm wireline and mud rotary methods.</p>	<p>PROJECT NAME VALLEY WASTE - PHASE II PROJECT NUMBER CO6464A</p>
<p>S = SPLIT SPOON SAMPLE U = UNDISTURBED SAMPLE  = GROUNDWATER</p>	

BORING LOCATION SECTION 17	DATE (START / FINISH) 8/03/2006 - 8/06/2006	Boring Log for
GROUND ELEVATION 427.9	DRILLED BY CASCADE DRILLING	CYM-17K1
GROUNDWATER EL.	LOGGED BY JC	
DATE 9/15/2006	EASTING 1513387.4	NORTHING 696298.9
	TOTAL DEPTH (FT) 350	Page 3 of 10

EL.	DEPTH	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
FT.	FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			

								fines, moist to very moist, olive, 5Y (5/4).
		C-12		60	7			
								77.5'-77.8': Silty sand (SM), fine grained sand, ~20% non plastic fines, moist to very moist, olive, 5Y (5/4).
350	78							77.8'-78.0': Clayey sand (SC), very fine grained sand, ~10% non plastic fines, moist, pale olive, 5Y (6/4).
		C-13		60	60			78.0'-80.0': Clayey sand (SC), very fine grained sand, ~10% medium plastic fines, moist, olive, 5Y (5/4).
								80.0'-81.0': Silty sand (SM), slightly clayey, ~10-20% non plastic fines, moist, olive, 5Y (5/4).
								81.0'-82.8': Silty clay (CL), ~20-30% high plastic fines, moist, olive, 5Y (5/4).
		C-14		60	18			82.8'-87.3': Silty sand (SM), slightly clayey, very fine grained sand, moist, olive, 5Y (5/4).
								87.3'-88.0': Clay (CL), 100 % high plastic fines, slightly silty, moist, olive, 5Y (5/4).
340	88							88.0'-88.5': Clayey sand (SC), very fine grained, ~10% high plastic fines, moist, pale olive, 5Y (6/3).
		C-15		60	60			88.5'-91.0': Clay (CL), 100% high plastic fines, moist, olive, 5Y (5/3).
								91.0'-91.5': Silty sand (SM), slightly clayey, ~10% non plastic fines, moist, light olive, gray, 5Y (6/2).
								91.5'-93.0': Clay (CL), slightly silty, ~80% high plastic fines, moist, olive, 5Y (5/3).
		C-16			48			93.0'-95.8': Clay (CL), slightly silty, ~90% high plastic fines, moist, olive, 5Y (5/3).
								95.8'-98.0': Clayey sand (SC), fine grained sand, ~10% high plastic fines, moist, olive, 5Y 95/3).
330	98							98.0'-103.0': Poorly graded sand (SP), fine to medium grained sand, moist to very moist, olive to light olive gray, 5Y (5/3) to 5Y (6/2).
		C-17		60	48			
								103.0'-108.0': Clay (CL), 100% high plastic fines, moist, olive, 5Y (4/3).
		C-18		60	60			
320	108							

NOTES: 1) Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment.
2) The well was drilled using air and mud rotary drilling techniques.
3) Cored using a 94mm wireline and mud rotary methods.

PROJECT NAME
VALLEY WASTE - PHASE II
PROJECT NUMBER
CO6464A



S = SPLIT SPOON SAMPLE

U = UNDISTURBED SAMPLE

≡ = GROUNDWATER

BORING LOCATION SECTION 17		DATE (START / FINISH) 8/03/2006 - 8/06/2006		Boring Log for CYM-17K1	
GROUND ELEVATION 427.9		DRILLED BY CASCADE DRILLING			
GROUNDWATER EL. _____		LOGGED BY JC		Page 4 of 10	
DATE 9/15/2006	EASTING 1513387.4	NORTHING 696298.9	TOTAL DEPTH (FT) 350		

EL. FT.	DEPTH FT.	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			
110		C-19		60	60			108.0'-111.5': Clay (CL), 100% high plastic fines, moist, olive, 5Y (4/3).
112								111.5'-112.0': Interbedded clay and sand, fine to medium grained sand, ~40% high plastic fines, moist, pale olive to olive, 5Y (6/3) to 5Y (5/3).
114		C-20		60	25			112.0'-116.0': Clay (CL), 100% high plastic fines, moist, olive, 5Y (5/3).
116								116.0'-118.0': Silty sand (SM), fine grained sand, ~10-20% non plastic fines, moist, olive, (5/3).
310	118	C-21		60	54			118.0'-123.0': Poorly graded sand (SP), fine to medium grained sand, ~5% non plastic fines, moist to very moist, pale olive to olive, 5Y (6/3) to 5Y (5/3).
120								123.0'-126.0': Poorly graded sand (SP), fine to medium grained sand, ~5% non plastic fines, moist to wet, olive, 5Y(5/3).
122								126.0'-128.5': Silty clay (CL), ~80-90% high plastic fines, moist to very moist, olive, 5Y (5/3).
124		C-22		60	30			128.5'-129.0': Poorly graded sand (SP), fine to medium grained sand, ~5% non plastic fines, moist, olive, 5Y (5/4).
126								129.0'-134.3': Silty clay (CL), ~10% non plastic fines, moist to very moist, olive, 5Y (5/3).
300	128	C-23		60	60			134.3'-135.5': Clayey sand (SC), ~10% high plastic fines, moist, olive, 5Y (5/3).
130								135.5'-136.9': Silty clay (CL), ~80% high plastic fines, moist, olive, 5Y (5/3).
132								136.9'-137.0': Silty sand (SM), ~10% non plastic fines, moist, olive, 5Y (5/3).
134		C-24		60	60			137.0'-143.0': Silty clay (CL), ~80-90% high plastic fines, moist, olive, 5Y (5/4).
136								143.0'-145.0': Silty clay (CL), ~80% high plastic fines, moist, light olive brown, 2.5Y (5/3).
290	138	C-25		60	60			
140								
142								
144		C-26		60	40			

NOTES: 1) Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment.
 2) The well was drilled using air and mud rotary drilling techniques.
 3) Cored using a 94mm wireline and mud rotary methods.

PROJECT NAME
VALLEY WASTE - PHASE II
 PROJECT NUMBER
CO6464A



S = SPLIT SPOON SAMPLE

U = UNDISTURBED SAMPLE

≡ = GROUNDWATER

BORING LOCATION SECTION 17	DATE (START / FINISH) 8/03/2006 - 8/06/2006	Boring Log for
GROUND ELEVATION 427.9	DRILLED BY CASCADE DRILLING	CYM-17K1
GROUNDWATER EL.	LOGGED BY JC	
DATE 9/15/2006	EASTING 1513387.4	NORTHING 696298.9
	TOTAL DEPTH (FT) 350	Page 5 of 10

EL.	DEPTH	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
FT.	FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			

280	146							145.0'-148.2': Clayey sand (SC), ~10% high plastic fines, moist, to very moist, light olive brown, 2.5Y (5/3).
	148	C-27		60	60			148.2'-150.0': Silty sand (SM), slightly clayey, fine grained sand, ~10% non plastic fines, moist to very moist, light olive, brown, 2.5Y (5/4).
	150							150.0'-151.5': Poorly graded sand (SP), fine to medium grained sand, moist, light olive brown, 2.5Y (5/3).
	152							151.5'-152.0': Silty sand (SM), slightly clayey, fine grained sand, ~20% non plastic fines, moist, light olive brown, 2.5Y (5/3).
	154	C-28		60	60			152.0'-153.0': Poorly graded sand (SP), fine to medium grained sand, ~5% non plastic fines, moist, light yellowish brown, 2.5Y (6/4).
	156							153.0'-153.2': Clayey sand (SC), fine grained sand, ~10% high plastic fines, moist to very moist, light yellowish brown, 2.5Y (6/4).
	158							153.2'-160.0': Poorly graded sand (SP), fine to medium grained sand, moist to wet, light olive brown, 2.5Y (5/3).
270	160	C-29		60	60			160.0'-162.6': Clayey sand (SC), fine grained sand, ~10% high plastic fines, moist to wet, light olive brown, 2.5Y (5/3).
	162							162.6'-162.8': Poorly graded sand (SP), fine to medium grained sand, moist, ~10% non plastic fines, moist to very moist, light olive brown, 2.5Y (5/3).
	164	C-30		60	36			162.8'-164.0': Clayey sand (SC), fine grained sand, ~20% high plastic fines, moist, light yellowish brown, 2.5Y (6/3).
	166							164.0'-168.0': Poorly graded sand (SP), fine to medium grained sand, ~5% non plastic fines, moist to wet, dark yellowish brown (rust) to light olive brown, 10YR (4/4) to 2.5Y (5/3).
260	168	C-31		60	48			168.0'-173.0': Poorly graded sand (SP), fine to medium grained sand, ~5% non plastic fines, moist to wet, light yellowish brown, 2.5Y (6/4).
	170							173.0'-177.8': Poorly graded sand (SP), fine to medium grained sand, ~5% non plastic fines, wet, olive, 5Y (5/4).
	172							177.8'-178.0': Silty sand (SM), slightly clayey, fine grained sand, ~10-20% non plastic fines, very moist, olive, 5Y (5/4).
	174	C-32		60	36			178.0'-181.5': Gravel (GP), with coarse sand, wet, yellowish brown, brown, 10YR (5/4).
	176							
250	178	C-33		60	18			
	180							

NOTES: 1) Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment.
2) The well was drilled using air and mud rotary drilling techniques.
3) Cored using a 94mm wireline and mud rotary methods.

PROJECT NAME
VALLEY WASTE - PHASE II
PROJECT NUMBER
CO6464A



S = SPLIT SPOON SAMPLE

U = UNDISTURBED SAMPLE

≡ = GROUNDWATER

BORING LOCATION SECTION 17	DATE (START / FINISH) 8/03/2006 - 8/06/2006	Boring Log for
GROUND ELEVATION 427.9	DRILLED BY CASCADE DRILLING	CYM-17K1
GROUNDWATER EL. _____	LOGGED BY JC	
DATE 9/15/2006	EASTING 1513387.4	NORTHING 696298.9
	TOTAL DEPTH (FT) 350	Page 6 of 10

EL.	DEPTH	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
FT.	FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			

182								181.5'-183.0': Clayey sand (SC), fine grained sand, ~5-10% non plastic fines, moist, light yellowish brown, 2.5Y (6/4).
184	C-34			60	13			183.0'-188.0': Silty sand (SM), very fine sand, ~10-20% non plastic fines, very moist to wet, light yellowish brown, 2.5Y (6/4).
186								
188	C-35			60	60			188.0'-193.0': Silty clay (CL), very fine grained silt, ~90% high plastic fines, moist, olive, 5Y (5/3).
190								
192								
194	C-36			60	48			193.0'-196.0': Silty clay (CL), ~80-90% high plastic fines, moist, olive, 5Y (4/3).
196								
198	C-37			60	60			196.0'-198.0': Poorly graded sand (SP), fine to coarse grained sand, veery moist, olive, 5Y (5/4).
200								198.0'-203.0': Clayey sand (SC), very fine grained sand, ~20-30% non plastic fines, moist, olive, 5Y (5/3).
202								
204	C-38			60	12			203.0'-204.0': Clayey sand (SC), very fine grained sand, ~10% non plastic fines, moist, olive, 5Y (5/3).
206								204.0'-208.1': Silty sand (SM), slightly clayey, ~20-30% non plastic fines, moist, olive, 5Y (5/3).
208	C-39			60	60			208.1'-210.0': Clay (CL), 100% high plastic fines, moist, dark greenish gray, 2 for GLEY (4/1).
210								210.0'-212.0': Sandy clay (CLS), ~80% high plastic fines, moist, greenish gray, 2 for GLEY (5/1).
212								212.0'-214.5': Clayey sand (SC), fine grained sand, ~20% non plastic fines, moist, greenish gray to olive, 2 for GLEY (5/1) to 2 for GLEY (5/4).
214	C-40			60	60			214.5'-215.8': Sandy clay (CLS), ~80% high plastic fines, moist, olive 5Y (5/3).
216								215.8'-216.2': Silty sand (SM), ~10% non plastic fines, moist, olive,

NOTES: 1) Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment.
2) The well was drilled using air and mud rotary drilling techniques.
3) Cored using a 94mm wireline and mud rotary methods.

PROJECT NAME
VALLEY WASTE - PHASE II
PROJECT NUMBER
CO6464A

S = SPLIT SPOON SAMPLE

U = UNDISTURBED SAMPLE

Σ = GROUNDWATER



BORING LOCATION SECTION 17		DATE (START / FINISH) 8/03/2006 - 8/06/2006		Boring Log for CYM-17K1	
GROUND ELEVATION 427.9		DRILLED BY CASCADE DRILLING			
GROUNDWATER EL. _____		LOGGED BY JC		Page 9 of 10	
DATE 9/15/2006		EASTING 1513387.4			
				TOTAL DEPTH (FT) 350	

EL. FT.	DEPTH FT.	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			

290						Sample 8		Silty sand (SM), fine grained sand, moist, ~10% non plastic fines, olive gray, 5Y (5/2).
292								
294								
296								
298	130							
300						Sample 9		Silty sand (SM), fine to medium grained sand, ~10-20% non plastic fines, moist, olive, 5Y (5/3).
302								
304								
306								
308	120							
310						Sample 10		Silty sand (SM), slightly clayey, ~20-30%, non plastic fines, moist, olive, 5Y (5/3).
312								
314								
316								
318	110							
320						Sample 11		Silty sand (SM), very fine grained sand, ~20-30% non plastic fines, moist, olive, 5Y (5/3).
322								
324								

NOTES: 1)Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment.
2)The well was drilled using air and mud rotary drilling techniques.
3)Cored using a 94mm wireline and mud rotary methods.

PROJECT NAME
VALLEY WASTE - PHASE II
PROJECT NUMBER
CO6464A



S = SPLIT SPOON SAMPLE


U = UNDISTURBED SAMPLE


≡ = GROUNDWATER

BORING LOCATION <u>SECTION 17</u>		DATE (START / FINISH) <u>8/29/2006 - 9/05/2006</u>		Boring Log for CYM-17M1	
GROUND ELEVATION <u>446.5</u>		DRILLED BY <u>CASCADE DRILLING</u>			
GROUNDWATER EL. _____		LOGGED BY <u>JC</u>		Page 2 of 10	
DATE <u>8/29/2006</u>		EASTING <u>1511084.6</u>			
				TOTAL DEPTH (FT) <u>350</u>	

EL. FT.	DEPTH FT.	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			

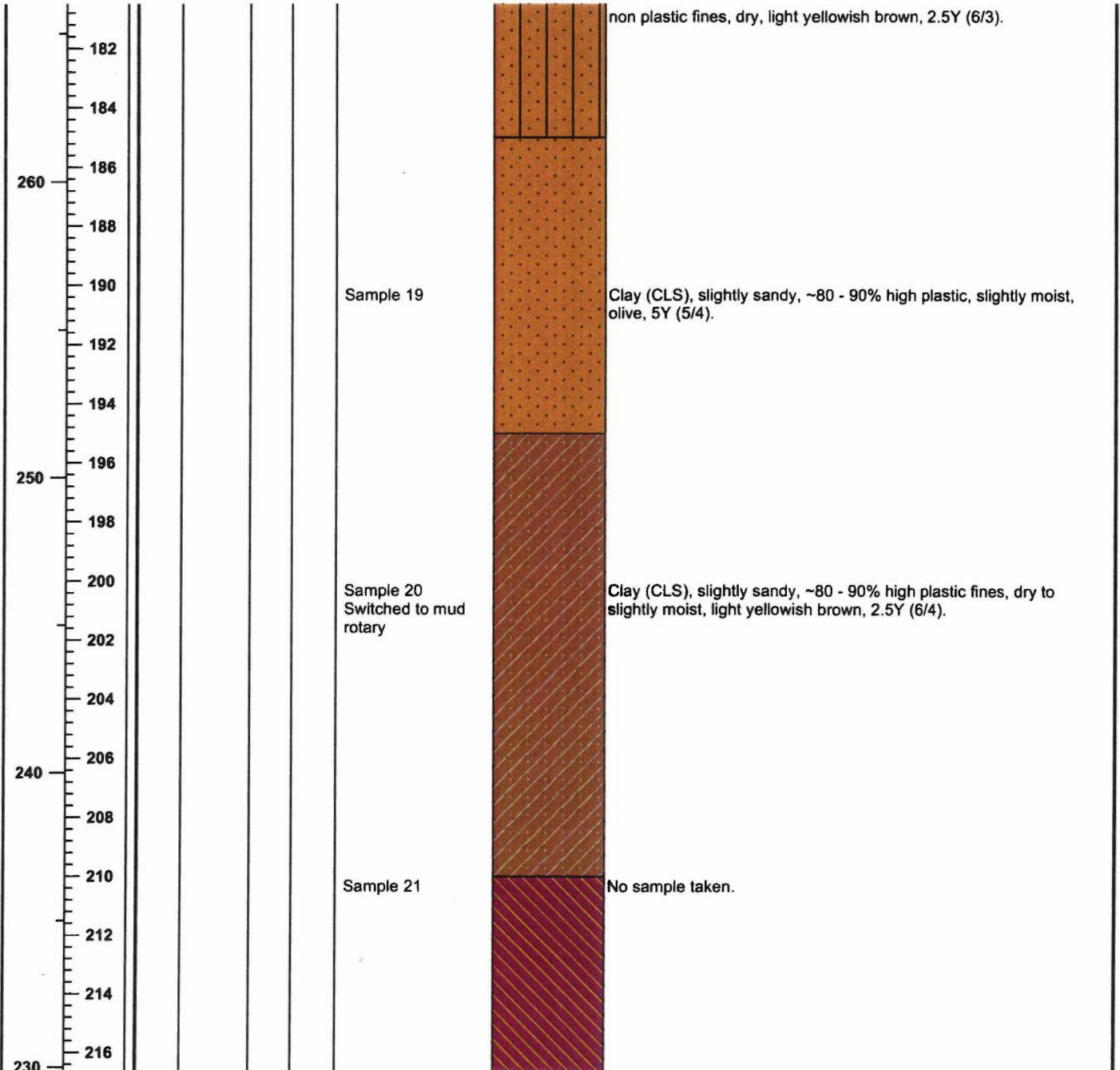
410								
38								
40						Sample 4		Silt (ML), very fine grained, ~90% non plastic fines, dry, pale yellow, 2.5YR (8/4).
42								
44								
46								
400								
48								
50						Sample 5		Silt (ML), very fine grained, ~90% non plastic fines, dry, pale yellow, 2.5YR (8/4).
52								
54								
56								
390								
58								
60						Sample 6		Silt (ML), very fine grained, ~90% non plastic, dry to slightly moist, pale yellow, 2.5YR (8/4).
62								
64								
380								
66								
68								
70						Sample 7		Silt (ML), very fine grained sand, ~80% non plastic fines, dry, pale yellow, 2.5Y (7/4).
72								


NOTES: 1)Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment. 2)The well was drilled using air and mud rotary drilling techniques. 3)Cored using a 94mm wireline and mud rotary methods.	PROJECT NAME VALLEY WASTE - PHASE II PROJECT NUMBER CO6464A
	

S = SPLIT SPOON SAMPLE	U = UNDISTURBED SAMPLE	 = GROUNDWATER
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BORING LOCATION <u>SECTION 17</u>		DATE (START / FINISH) <u>8/29/2006 - 9/05/2006</u>		Boring Log for	
GROUND ELEVATION <u>446.5</u>		DRILLED BY <u>CASCADE DRILLING</u>		CYM-17M1	
GROUNDWATER EL. _____		LOGGED BY <u>JC</u>			
DATE <u>8/29/2006</u>		EASTING <u>1511084.6</u>		NORTHING <u>696235.6</u> TOTAL DEPTH (FT) <u>350</u>	
Page 6 of 10					

EL. FT.	DEPTH FT.	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			



NOTES: 1) Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment. 2) The well was drilled using air and mud rotary drilling techniques. 3) Cored using a 94mm wireline and mud rotary methods.		PROJECT NAME VALLEY WASTE - PHASE II PROJECT NUMBER CO6464A
S = SPLIT SPOON SAMPLE U = UNDISTURBED SAMPLE ▬ = GROUNDWATER		

BORING LOCATION <u>SECTION 17</u>		DATE (START / FINISH) <u>8/29/2006 - 9/05/2006</u>		Boring Log for CYM-17M1
GROUND ELEVATION <u>446.5</u>		DRILLED BY <u>CASCADE DRILLING</u>		
GROUNDWATER EL. _____		LOGGED BY <u>JC</u>		
DATE <u>8/29/2006</u>	EASTING <u>1511084.6</u>	NORTHING <u>696235.6</u>	TOTAL DEPTH (FT) <u>350</u>	Page 7 of 10

EL. FT.	DEPTH FT.	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			
218								
220						Sample 22		Clay (CL), ~100% high plastic fines, ligh olive brown, 2.5Y (5/3).
222								
224								
226								
228								
230						Sample 23		Poorly graded sand (SP), fine to medium grained sand, ~5 - 10% non plastic fines, olive, 5Y(5/3).
232								
234								
236								
238								
240						Sample 24		Poorly graded sand (SP), fine to medium grained sand, <5% non plastic fines, light olive brown, 2.5Y (5/3).
242								
244								
246								
248								
250						Sample 25		Clayey sand (SC), fine grained sand with clay, ~20 - 30 % high plastic fines, pale olive, 5Y (6/3).
252								

NOTES: 1) Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment.
 2) The well was drilled using air and mud rotary drilling techniques.
 3) Cored using a 94mm wireline and mud rotary methods.

PROJECT NAME
VALLEY WASTE - PHASE II
 PROJECT NUMBER
CO6464A



S = SPLIT SPOON SAMPLE

U = UNDISTURBED SAMPLE

≡ = GROUNDWATER

BORING LOCATION <u>SECTION 17</u>		DATE (START / FINISH) <u>8/29/2006 - 9/05/2006</u>		Boring Log for CYM-17M1	
GROUND ELEVATION <u>446.5</u>		DRILLED BY <u>CASCADE DRILLING</u>			
GROUNDWATER EL. _____		LOGGED BY <u>JC</u>		Page <u>9</u> of <u>10</u>	
DATE <u>8/29/2006</u>		EASTING <u>1511084.6</u>			
				TOTAL DEPTH (FT) <u>350</u>	

EL. FT.	DEPTH FT.	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			
	290					Sample 29		Poorly graded sand (SP), fine to coarse sand, ~10% non plastic fines, light yellowish brown, 2.5Y (6/4).
	292							
	294							
	296							
150	298							
	300					Sample 30		
	302							
	304							
	306							
140	308							
	310					Sample 31		
	312							
	314							
	316							
130	318							
	320					Sample 32		
	322							
	324							

NOTES: 1) Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment.
 2) The well was drilled using air and mud rotary drilling techniques.
 3) Cored using a 94mm wireline and mud rotary methods.

PROJECT NAME
VALLEY WASTE - PHASE II
 PROJECT NUMBER
CO6464A



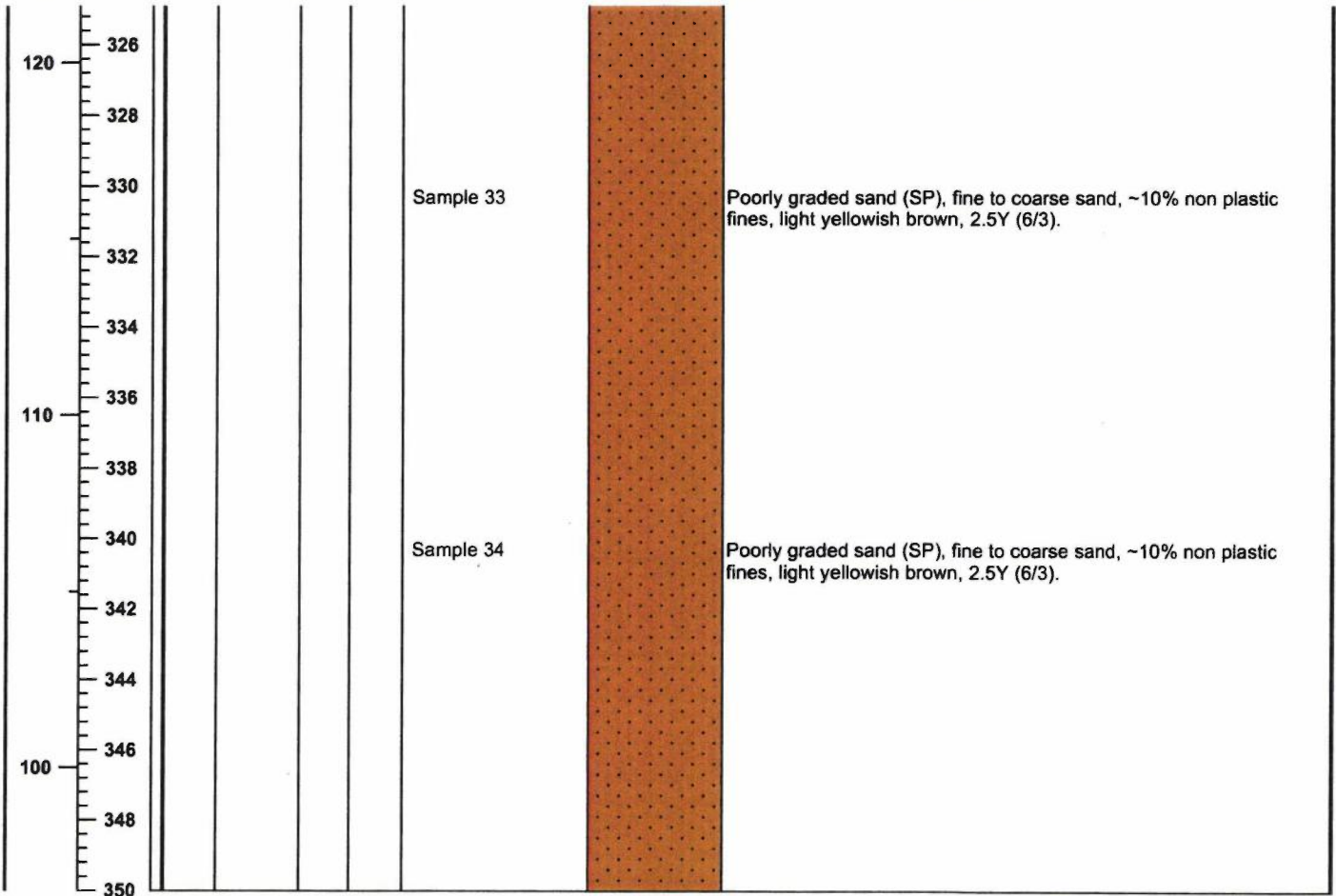
S = SPLIT SPOON SAMPLE


U = UNDISTURBED SAMPLE


≡ = GROUNDWATER

BORING LOCATION SECTION 17		DATE (START / FINISH) 8/29/2006 - 9/05/2006		Boring Log for CYM-17M1	
GROUND ELEVATION 446.5		DRILLED BY CASCADE DRILLING			
GROUNDWATER EL. _____		LOGGED BY JC		Page 10 of 10	
DATE 8/29/2006		EASTING 1511084.6			
				TOTAL DEPTH (FT) 350	

EL. FT.	DEPTH FT.	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			




NOTES: 1)Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment. 2)The well was drilled using air and mud rotary drilling techniques. 3)Cored using a 94mm wireline and mud rotary methods.	PROJECT NAME VALLEY WASTE - PHASE II PROJECT NUMBER CO6464A
	

S = SPLIT SPOON SAMPLE	U = UNDISTURBED SAMPLE	 = GROUNDWATER
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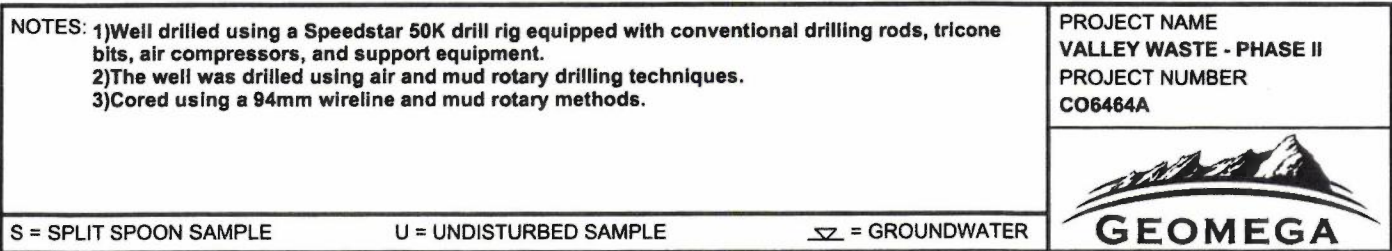
BORING LOCATION SECTION 17		DATE (START / FINISH) 8/17/2006 - 8/20/2006		Boring Log for	
GROUND ELEVATION 437.6		DRILLED BY CASCADE DRILLING		CYM-17Q1	
GROUNDWATER EL.		LOGGED BY JC		Page 1 of 10	
DATE 8/17/2006		EASTING 1514439.9		NORTHING 694727.9 TOTAL DEPTH (FT) 350	

EL. FT.	DEPTH FT.	SAMPLE				PID and REMARKS	GRAPHIC LOG	SOIL and ROCK DESCRIPTIONS
		TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC. IN.			

0								
2								
4								
6								
8	430					Sample 1		Silt (ML), very fine grained, like powder, ~80 - 90% non plastic fines, dry, yellow, 10YR (7/6).
10								
12								
14								
16								
18	420					Sample 2		Silt (ML), very fine grained, like powder, ~80 - 90% non plastic fines, dry, yellow, 10YR (8/6)
20								
22								
24								
26								
28	410					Sample 3		Silt (ML), very fine, like powder, ~80 - 90% non plastic fines, dry, very pale brown, 10YR (8/4).
30								
32								
34								
36								

NOTES: 1)Well drilled using a Speedstar 50K drill rig equipped with conventional drilling rods, tricone bits, air compressors, and support equipment. 2)The well was drilled using air and mud rotary drilling techniques. 3)Cored using a 94mm wireline and mud rotary methods.	PROJECT NAME VALLEY WASTE - PHASE II PROJECT NUMBER CO6464A
	

S = SPLIT SPOON SAMPLE	U = UNDISTURBED SAMPLE	≡ = GROUNDWATER
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[illegible]

Hydrogeologic Characterization Report Valley Waste Disposal Company Cymric Field Study Area

Prepared for:

Valley Waste Disposal Company
1400 Easton Drive, Suite 139-B
Bakersfield, California 93309

March 16, 2004



geomega
good science • hard work • creative thinking

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Executive Summary



EXECUTIVE SUMMARY

Valley Waste Disposal Company (VWDC) has completed a hydrogeologic investigation of the Cymric Field Study Area to evaluate groundwater regimes in this region of the southern San Joaquin Valley. This investigation focused on the Cymric Field area located 7 miles north of the town of McKittrick, California, and it followed the procedures for field and office tasks as outlined in the workplan submitted to the California Regional Water Quality Control Board, Central Valley Region-Fresno Branch (RWQCB) (Geomega 2002a). The VWDC Cymric impoundments, McKittrick 1 and McKittrick 1-3 (referred to as the Cymric ponds), have been intermittently receiving excess produced water from oil and gas producers in the area since their construction. Excess produced water is delivered to the facility via pipelines from oil and gas leases west of the Cymric Ponds.

The field data acquisition phase of the investigation involved drilling three boreholes to acquire whole core and geophysical logs of the alluvial aquifer units above the Corcoran Clay Equivalent (CCE), installing three groundwater monitoring wells, collecting water samples from the monitoring wells, and performing slug tests on the three monitoring wells. Drilling locations were challenging to spot and time consuming to obtain access and permit for, because the study area is located within a wildlife habitat area protected by Kern County and various Federal agencies.

Silty clay layers within the shallower alluvial fan sequence act to perch groundwater in the Cymric area. Multi-perched water zones in the alluvial fan sequence encountered in borehole/monitoring wells CYM-17N1 and CYM-19H1 are apparent from air rotary drilling and geophysical log interpretation. Perched groundwater was sampled at monitoring well locations CYM-17N1 and CYM-19H1 in alluvial fan hydrostratigraphic units within 170 feet of the ground surface. Estimated hydraulic conductivities, calculated from slug test results, ranged from 3×10^{-3} to 2×10^{-4} cm/sec in this upper alluvial aquifer, which is consistent with literature

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values for sand and silty sand formations. Groundwater gradient and Darcy velocity could not be determined for the shallower perched aquifers, since there were not three wells completed in a correlative aquifer unit.

A deeper, thin lacustrine sheet sand hydrostratigraphic unit was encountered at well location CYM-21D. First groundwater in the CYM-21D1 was detected at 286 feet in the deeper lacustrine unit while drilling with air rotary methods in a lower, unconfined aquifer near the top of the CCE. This was the only well completed in the lower lacustrine sheet sand unit. Slug test results for well CYM-21D1 are suspect due to the short water column encountered in the well bore. The CYM-21D was devoid of groundwater in the upper alluvial fan hydrostratigraphic equivalents where water was detected in CYM-17N1 and CYM-19H1. Groundwater gradient and Darcy velocity for this deeper aquifer could not be determined from the data collected, since only one well evaluated groundwater in this unit.

Water samples collected from the three wells and the VWDC pond facility were analyzed for geochemical constituents and stable oxygen (O) and hydrogen (H) isotopes to determine groundwater composition. Results of the geochemical analysis were plotted on stiff, piper, and bilinear diagrams, which characterize water samples according to select ionic types. Analytical results indicate that groundwater samples collected from the upper alluvial fan units in monitoring wells CYM-19H1 and CYM-17N1, located approximately 0.25 and 0.75 miles northeast of the VWDC Cymric ponds, respectively, contain produced water. Geochemical analysis of groundwater collected from the deeper lacustrine unit in monitoring well CYM-21D1, located approximately 1.25 miles east of the Cymric ponds, appears to consist of native water.

It appears that produced water from oilfield disposal management activities at the Cymric Field is present 0.75 miles northeast of the pond system in monitoring well CYM-17N1, and it is constrained in the shallower perched aquifer unit. The lateral and vertical extent of the produced water has not been determined from this investigation.

Additional field investigation is recommended to better characterize the hydrogeology of the Cymric area, to determine the geochemistry of native water in the shallow alluvial units, and to delineate the extent of produced water in the subsurface. Locating and drilling additional monitoring wells in the Cymric Study Area may be challenging because they will be positioned in a protected wildlife habitat area.

Text

1 INTRODUCTION

This report is submitted by Valley Waste Disposal Company (VWDC) to the California Regional Water Quality Control Board, Central Valley Region-Fresno Branch (RWQCB) to fulfill requirements of a letter request to perform additional field investigation at Cymric (RWQCB 2001). Geomega Inc. (Geomega) was retained by VWDC to investigate the groundwater hydrogeology adjacent to their Cymric ponds in this region of the southern San Joaquin Valley. This report documents the results of a drilling and monitoring well installation program and subsurface hydrogeologic characterization of Cymric completed by Geomega.

1.1 Area of Investigation

The Cymric Field Study Area is located in western Kern County approximately 38 miles west of Bakersfield, California. The study area encompasses approximately 4 square miles (Figure 1). The area of this investigation is north and east of VWDC's McKittrick 1 and McKittrick 1-3 facilities (Cymric ponds), towards the Clean Harbors Facility. The location of the VWDC Cymric pond facilities and the area of investigation are shown in Figure 1.

1.2 Project Background

A surface geophysical investigation was recently performed on the VWDC McKittrick 1 and 1-3 facilities, located just east of the Cymric Oilfield to determine the areal and vertical extent of produced water migration downgradient of this percolation pond system (Strata Geophysical 2000). However, the surface geophysical survey was ambiguous in delineating the extent of produced water migration at this site. VWDC forwarded recommendations to the RWQCB that a conventional subsurface investigation of the area be performed to characterize the hydrogeologic conditions near the ponds. The RWQCB concurred with this recommendation and requested that a work plan be developed for a more conventional subsurface investigation, which includes borings, geophysical logs and groundwater samples

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(RWQCB April 2001).

Geomega developed and submitted a workplan proposing additional characterization of the Cymric Field area to determine the hydrogeologic conditions and the extent of produced water downgradient of the VWDC Cymric facility (Geomega 2002a).

1.3 Objectives and Approach

The objectives of the borehole and monitoring well installation program were to gather hydrogeology and geochemistry data from the uppermost alluvial groundwater zone downgradient from VWDC's facilities in the Cymric Study Area in order to characterize the hydrogeologic conditions adjacent to the VWDC McKittrick 1 and 1-3 disposal facilities. Additionally, the extent of the produced water mixing front, if any, downgradient of the VWDC McKittrick 1 and 1-3 facilities was to be delineated.

On the basis of reviewing select groundwater data from the Clean Harbors facility (formerly Laidlaw and Safety Kleen), well logs from Chevron Eklund USL 56-18 and VWDC 19-2, and experience gained from the west Belridge Hydrogeologic Study (Geomega 2001), an investigative approach similar to the one recommended for the VWDC Maricopa Flats Phase II study (Geomega 2002b) was proposed and approved. The recommended approach of this investigation included installing three monitoring wells situated in a triangular pattern east and northeast of the Cymric ponds (Figure 1) to gather new hydrogeologic and geochemical data to characterize the groundwater flow system in the study area. The following data were gathered during the hydrogeologic investigation:

- Whole core intervals adjacent to the water table from each borehole.
- Geophysical logs.
- Groundwater levels, samples and laboratory analyses for inorganic, organic, and stable oxygen/hydrogen isotopes from each monitoring well.

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- In-situ aquifer testing (slug test).

2 DRILLING PROGRAM

Well CYM-19H1 was installed in the northeast corner of Section 19, approximately 0.25 miles down topographic slope from the pond facility. Well CYM-17N1 was installed in the southwest corner of Section 17 approximately 0.75 miles northeast of the VWDC Cymric facility. CYM-21D1 was installed in the northwest corner of Section 21 approximately 1.25 miles east of the Cymric facility to evaluate the shallow hydrology in that vicinity.

Each borehole was advanced approximately 100 feet into the saturated alluvium sediments, or to the top of the Corcoran Clay Equivalent (CCE), which is the transitional unit between the Holocene alluvium and the Pleistocene Tulare Formation. This was done to allow enough borehole for the geophysical logging tools to record the interface between the vadose zone and water-saturated sediments, and to compensate for under prediction of the water table surface. Results of the drilling program are summarized in the table below. Well prefixes were assigned to correlate with the study area. Figure 1 shows the drilling locations for each of the three boreholes.

<u>Well ID</u>	<u>Location</u>	<u>Ground Surface Elevation (ft amsl)</u>	<u>Depth to Groundwater (ft bgs)</u>	<u>Borehole Total Depth (ft bgs)</u>
CYM-19H1	H, S19,T29S,R22E	469	129	245
CYM-17N1	N, S17,T29S,R22E	451	140	240
CYM-21D1	D, S21,T29S,R22E	427	286	300

These boreholes were installed to characterize the groundwater hydrology conditions adjacent to the site and downgradient of the Cymric ponds. A summary of borehole data is included in Table 1.

2.1 Borehole Drilling

The three boreholes were drilled to the first occurrence of groundwater (as identified by the supervising field geologist) using air rotary drilling while advancing casing. After encountering first groundwater, the casing advanced for air drilling was pulled, and the drilling was switched to the mud rotary method to total depth of each borehole. A 50-foot surface conductor casing was left in the hole to control the shallow unconsolidated sediments and minimize lost circulation problems. This combination of drilling methods provided definitive interpretation of the local water table during drilling and allowed for a complete suite of geophysical logs to be obtained before constructing the monitor well.

Geophysical logs were obtained from 30 feet above total depth drilled (approximate geophysical tool length) to 20 feet from the ground surface (bottom of conductor pipe). Whole core samples were also collected from approximately the water table to total depth in each boring after changing over to mud rotary drilling. This combination of air and mud rotary drilling and collection of geophysical logs and whole core allows for sufficient data to be collected in order to characterize and monitor the hydrogeologic conditions of this area.

2.2 Soil Sampling

Continuous core samples were collected from each borehole using a 94-mm diameter Christensen coring system from near the water table to total depth. Approximately 100 feet of core was taken in each borehole. Core samples were retrieved in 5-foot barrels via a wire line run inside the drill pipe. The amount of core obtained in each borehole was determined in the field by the supervising geologist and verbal agreement with VWDC representatives.

A geologic record of the stratigraphy encountered, interpreted from the core samples, was documented for each borehole during drilling. Core samples were analyzed for lithology, presence of water and selection for additional soil property laboratory testing. Core samples

were then prepared and delivered to Goode Core Services in Bakersfield, California for photographic archival and laboratory sampling. Core photographs are provided in Appendix A.

2.3 Geophysical Logging

After each borehole was drilled to total depth, downhole wireline geophysical logging tools were used to describe the physical properties of the subsurface sediments encountered during drilling. Geophysical logging was conducted from total depth to the base of the conductor casing and included resistivity, spontaneous potential, natural gamma ray, caliper, bulk density, and neutron porosity logs. The log curves were used to identify subsurface lithologies, the presence of groundwater and aquifer-like zones capable of transmitting groundwater, potential aquitards, and to select the appropriate screened interval for each monitoring well. Additionally, these logs have also been employed to correlate the shallow stratigraphy with the limited historic well logs in the area. Copies of the geophysical logs for each borehole are included in Appendix B.

3 MONITORING WELL INSTALLATION

Following geophysical logging, the screened interval for each monitoring well was selected to straddle the apparent water table surface, which was interpreted from air rotary drilling results, core samples, and geophysical logs. Concurrence with the RWQCB for final screened intervals was verbally obtained prior to well construction. Wells were completed in the uppermost water-saturated zone with a 60-foot screened interval to allow for groundwater fluctuations. The screens were initially constructed with approximately 30% of slots above the water table and 70% below.

Results of the monitoring well drilling and construction are summarized in Table 2. Copies of the geology borehole logs, well construction logs, as-built well location surveys, and well permits are provided in Appendix C.

3.1 Completion Methods

Each well was completed using 5-inch diameter (4.75-inch I.D., 5.50-inch OD), schedule 80 PVC, flush-thread well casing. Screens consisted of 0.020-inch factory made slots. General well completion procedures are described below.

1. Determined desired completion interval based upon air rotary drill samples, core samples and geophysical logs.
2. Back-filled bottom of borehole to approximately 15 feet below well completion interval using cement grout and bentonite pellets.
3. Assembled and lowered desired length of well screen, threaded end cap, 10-foot blank section (silt trap), and enough blank casing to set screen at predetermined completion depth.

4. Lowered tremie pipe down annulus between borehole wall and casing to total depth.
5. Installed gravel pack using No. 3 Monterey sand from back-filled total depth to approximately 5 feet above the top of the well screen.
6. Placed a 5-foot bentonite seal above sand pack.
7. Grouted borehole annulus from top of bentonite seal to ground surface with a 10:1 mixture of Type I/II cement and bentonite in 100-foot lift intervals to ensure the PVC did not collapse or melt.
8. Notified Kern County Environmental Health Services of pending surface seal grouting and allowed them adequate time to witness seal.
9. Pulled out surface casing and cut PVC casing stick-up to approximately 2.5 feet above ground surface.
10. Installed steel well protector, locking cap over PVC stick-up, and concrete apron with four corner traffic posts.
11. Surveyed well locations, elevations of ground surface and top of casing.

All state and county monitor well construction requirements and procedures were strictly followed during well construction.

3.2 Monitoring Well Development

After the grout had sufficiently cured, each monitoring well was developed using a combination of air-lifting, bailing, swabbing, surging and pumping to remove drilling mud and fine grained material from the well screen and filter pack. During well development, field parameters including pH, temperature and specific conductance were monitored. The well was considered to be fully developed after the field parameters stabilized within 5 percent of the previous reading.

3.3 Groundwater Sampling

In November 2002, following well development, representative groundwater samples were collected from each of the three monitoring wells using a submersible pump. State accepted groundwater sampling procedures were followed during the collection of the water samples. Chain-of-custody records were prepared in the field and accompanied the samples to a state-certified laboratory. Samples were stored on ice in an insulated container at 4°C, as appropriate. Water samples were submitted to state-certified laboratories for the following analyses:

- general inorganics,
- total petroleum hydrocarbons (TPH),
- aromatic hydrocarbons (BTEX), and
- stable oxygen/hydrogen isotopes

Oxygen and hydrogen isotopic compositions of water samples were analyzed to estimate groundwater origin. Static water level and well total depth were measured during the sampling event. Each sample was properly labeled to document well number, date, time, and sampler.

4 HYDROGEOLOGY

4.1 Regional Hydrogeologic Setting

The Cymric study area is located in the southwestern San Joaquin Valley, situated just east of the Cymric Oilfield and the Temblor Hills. This is an area of intense and recent structural disturbance due to range front thrusting and strike slip movement in relation to the San Andreas Fault zone. Compressive tectonic forces related to movement along the San Andreas Fault zone have formed subsurface anticlinal structures and deeply rooted normal and reverse faults along the southwestern margin of the San Joaquin basin. Thick sedimentary deposits of relatively young age filled up the basin. The San Joaquin Valley is a north south trending basin residing between the Temblor Range of the Franciscan Complex to the west and the Sierra Batholith to the east. The west side of this basin has been filled with marine-derived sediments originating from the nearby Temblor and Coastal Ranges, forming shallow horizons dipping to the east toward the axis of the San Joaquin basin.

The structural and stratigraphic development of geologic formations along the southwestern margin of the San Joaquin Valley during the Plio-Pleistocene age through present (Tulare Formation and alluvium) has resulted in a unique and complex hydrogeologic environment. The southern San Joaquin Valley, east of the Coastal Range/Temblor Hills, represents the transitional area between a large regional hydrogeological system of the central San Joaquin Valley and localized groundwater sources that occur along the uplifted western margin of this intermontane basin. The convergence of different depositional systems in this area creates a complex environment of interfingered sedimentary layers, which results in hydraulic conductivity variations and vertical barriers (aquitards) within the groundwater basin, as well as geochemical changes caused by separate water sources and rock-water interaction.

Holocene deposits of the southwestern San Joaquin Valley consist of alluvial fans derived from

the Coastal Range, while the central and eastern Valley deposits are alluvial fan and lacustrine deposits sourced from the Sierra Batholith. Groundwater on the west side of the San Joaquin Valley is a sulfate-enriched water with TDS typically between 6,000 and 3,000 ppm, because these host soils were derived from Coastal Range marine rocks which contained saline connate water. Resulting valley fill alluvial fan deposits are alkaline-rich arid soil horizons, incapable of forming fresh water aquifers. Groundwater with less than 3,000 TDS is first encountered along the Main Drain and Central Valley canal system that is coincidental with the axis of the valley (Davis and Coplen 1989).

4.2 Local Hydrogeologic Setting

In general within the Cymric area, the hydrogeologic environment consists of uplifted arid alluvial fan systems underlain by lacustrine sands and the regional Corcoran Clay Equivalent (CCE). The alluvial fan deposits originated in the Coastal Ranges west of Cymric. The alluvial fan systems form where high-gradient streams carrying detritus from the Coastal Range west of the Cymric area enter the relatively flat San Joaquin Valley floor (near the Cymric study area). A thick silty-clay section is found at the base of the alluvial fan sequences in the Cymric area and is indicative of an alluvial plain to lacustrine depositional environment transition. Lacustrine deposits occur near the base of the Holocene section in the Cymric Field study area. A shoreline sheet sand that represented the last regressive sequence of the paleo San Joaquin embayment is encountered on top of the CCE within the study area. The CCE is a stiff organic-rich clay which separates the Holocene alluvium from the Pleistocene Tulare hydrostratigraphic units.

Figure 2 is a type log and stratigraphic section representing the hydrogeology interpretation for the Cymric study area. There are two types of hydrostratigraphic aquifer units present: perched groundwater in shallower sandy alluvial fan units, and unconfined groundwater in deeper lacustrine sands near the base of the Holocene and just above the CCE. Meteoric water entering the groundwater basin through alluvial fan deposits is typically limited in

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supply and more mineralized as a result of infiltration through arid and marine-derived sediments.

4.2.1 Alluvial Sediments

Unconsolidated Holocene alluvial plain sediments are encountered across the Cymric area at the ground surface. The alluvium varies in thickness from less than 200 feet to over 300 feet, based on borehole cuttings, core samples, and geophysical log interpretation. This package of sediments consists of a series of alluvial fan sequences sourced in the Temblor Hills and Elk Hills, which prograded eastward toward the axis of the San Joaquin Valley. The alluvium is present from ground surface to 206 feet bgs in CYM-19H1, to 195 feet bgs in CYM-17N1, and to 270 feet bgs in CYM-21D1. Soil types in this horizon are characterized by silty sands to sand layers interbedded with variably thick lenses of stiff clay to silty clay. Silty sand layers are composed of yellowish brown, very fine to medium, subangular to rounded sand grains, generally well sorted. Interbeds of yellowish brown, soft to very stiff silty clays occur between the sandy layers. Lenses of poorly sorted, angular to subangular gravelly sands occasionally occur in the interbedded sequence (Figure 3 and Appendix A).

4.2.2 Corcoran Clay Equivalent

The CCE appears to be a pervasive aquitard in the area, note the desaturated geophysical log response (suppressed neutron porosity curve and enhanced resistivity curve) over the upper portion of the deeper Holocene sheet sand hydrostratigraphic unit in all of the boreholes (CYM-17N1, CYM-19H1, and CYM-21D1, Appendix B). This clay acting in unison with the stiff silty clay lenses of the alluvial fan system, partitions groundwater in sandy units of the alluvium within the Cymric area. The CCE is a widespread lacustrine clay package that demarcates the transition from Holocene alluvium to Pleistocene Tulare deposition. It is stratigraphically positioned just below the lacustrine sheet sand and above the underlying upper Tulare Formation. This clay is characterized by an olive gray, stiff to hard, highly plastic, organic-rich clay to silty clay, containing minor amounts of dark mottling (239 feet in CYM 17N1, 240 feet in CYM-19H1, and 288 feet in CYM-21D1 core photographs,

Appendix A). The depositional environment of this clay interval is interpreted as a stagnant backwater-reducing environment resulting from a transgressional sequence of the Corcoran Lake across the southern San Joaquin Valley.

4.2.3 Perched Groundwater System

On the basis of air rotary drilling, well testing, and geophysical log interpretation, it appears that several silty clay layers within the alluvial fan sequence act locally to perch groundwater under water table conditions. There is an example of multi-perched water zones in the alluvial fan sequence in borehole/monitoring well CYM-19H1. A fine grained sandy unit was encountered from 125 to 155 feet bgs (CYM-19H1 borehole log, Appendix C) and tested first groundwater at 129 feet (Table 2). The top 4 feet of this sandy unit was unsaturated.

Groundwater in this sandy fan unit was perched on dense stiff silty clay from 155 to 180 feet bgs (CYM-19H1 core photographs, Appendix A). A coarse grained sandy unit was next penetrated in CYM-19H1 from 180 to 199 feet bgs (CYM-19H1 core photographs, Appendix A). According to the geophysical log, an air/water contact occurs in this sand unit at 191 feet bgs (CYM-19H1 geophysical log, Appendix B). Groundwater in this zone is apparently perching on a dense stiff clay unit encountered from 199 to 206 feet in CYM-19H1 (CYM-19H1 core photographs, Appendix A). Another coarse sand unit, from 206 to 239 feet bgs (CYM-19H1 core photographs, Appendix A), appears to be completely unsaturated at this location, on the basis of the geophysical log response (CYM-19H1 geophysical log, Appendix B). Apparently, the silty clay unit that is encountered from 199 to 206 feet in CYM-19H1 functions as a barrier to vertical flow and infiltration at this location. This sandy unit rests on top of the CCE, which is encountered at approximately 239 feet in CYM-19H1. This lowest sandy unit is the lacustrine sheet sand deposit that is stratigraphically equivalent to the deeper hydrostratigraphic unit, which was screened in monitoring well CYM-21D1.

4.2.4 Hydrostratigraphic Units Present at Cymric

A summary of the different hydrostratigraphic units encountered in the Cymric Field study area are summarized by a series of figures that combines core photographs with geophysical log

response and laboratory measurements of permeability. Laboratory measured permeabilities/hydraulic conductivities are summarized in Table 3. Core photographs of the sampled intervals for the three boreholes are included in Appendix A.

4.2.4.1 Alluvial Silty Sand

Figure 3 depicts an alluvial fan silty sand horizon encountered at 152 feet below ground surface in the CYM-17N1 well. This figure is representative of a typical AQI unit, and is an integrated graphic of core photograph, geophysical log response and laboratory permeability testing results. There is fairly good SP/gamma ray tool response, typical of a coarser grained strata, and the resistivity and neutron-density curve response indicates a 0.35 porosity water-bearing horizon.

4.2.4.2 Alluvial Sand

Figure 4 depicts an alluvial fan sand horizon encountered at 150 feet below ground surface in the CYM-19H1 well. This figure is representative of a coarser grain alluvial fan unit, and is an integrated graphic of core photograph, geophysical log response and laboratory permeability testing results. There is fairly good SP/gamma ray tool response, typical of a coarser grained strata, and the resistivity and neutron-density curve response indicates a 0.35 porosity water-bearing horizon. There is also evidence of drilling mud invasion on the resistivity log response (higher resistivity in the shallow tool). Permeability was calculated at 10 Darcy ($9.96\text{E-}03$ cm/sec) by the laboratory for this sand.

4.2.4.3 Silty Clay

Figure 5 depicts a silty-clay clay interval encountered at 270 feet below ground surface in the CYM-21D1 well. This figure is representative of a typical basal alluvial clay aquitard, and is an integrated graphic of core photograph, geophysical log response and laboratory permeability testing results. There is suppressed SP/gamma ray tool response, typical of finer grain strata, and the resistivity and neutron-density curve response indicates a 0.45 porosity zone, with enhanced neutron, typically seen in clays.

4.2.4.4 Lacustrine Sand

Figure 6 depicts a lacustrine sheet sand horizon encountered at 185 feet below ground surface in the CYM-19H1 well. This figure is representative of a well sorted coarse to medium grain sand, and is an integrated graphic of core photograph, geophysical log response and laboratory permeability testing results. There is fairly good SP/gamma ray tool response, typical of a coarser grained strata, and the resistivity and neutron-density curve response indicates a 0.38 porosity unsaturated horizon. There is also evidence of drilling mud invasion on the resistivity log response (higher resistivity in the shallow tool), indicative of a highly permeable media. Permeability was calculated at 20,362 Darcy (2.0×10^{-3} cm/sec) by the laboratory for this sand unit.

4.3 Groundwater Occurrence

Depth to groundwater within the study area was measured to be approximately 129, 140, and 285 feet below ground surface in monitoring wells CYM-19H1, CYM-17N1 and CYM-21D1, respectively (Table 1). The corresponding water elevations are approximately 340, 311 and 141 feet above mean sea level (amsl). Groundwater encountered in CYM-17N1 and CYM-19H1 occur in a similar shallow alluvial aquifer unit, that appears to be perched water on top of the alluvial clay horizons discussed in Section 4.2. These clays appear to separate the upper alluvial fan units from the lacustrine sheet sand present near the base of the alluvium and top of the CCE. First groundwater in CYM-21D1 was encountered beneath the alluvial fan sequence in a deeper and thin lacustrine sand unit. The shallower alluvial units were dry and void of groundwater at the CYM-21D1 location.

A water table flow direction and gradient cannot be calculated on the basis of the two monitoring wells completed in the upper alluvial hydrostratigraphic unit. A water table contour map of the upper alluvial unit cannot be constructed since there are not three completions in this

hydrostratigraphic unit from which to define a water table plane. Additional well completions in the Cymric area are necessary before groundwater flow vector(s) in the alluvial aquifers can be established.

4.4 Aquifer Testing

Following collection of groundwater samples, slug tests were conducted in CYM-19H1 and CYM-17N1 to estimate the hydraulic conductivity of the uppermost water-saturated zone in the study area. Slug tests were conducted by measuring initial water levels prior to lowering a slug (stainless steel bailer) below the static water level. After lowering the slug, sufficient time was allowed for the water level to return to its original position. When the slug was removed, a pressure transducer measured and recorded the change in water level (recharge) with the change in time. Test data were analyzed using the Bouwer-Rice curve matching solution to obtain an estimated hydraulic conductivity of the uppermost water-saturated zone (Bouwer-Rice, 1976).

Two separate slug tests were performed on CYM-19H1. Estimated hydraulic conductivities for CYM-19H1 ranged from 1.6×10^{-3} to 1.8×10^{-3} cm/second. The average hydraulic conductivity for CYM-19H1 was calculated to be 1.7×10^{-3} cm/second (Table 4). Two separate slug tests were performed on CYM-17N1. Estimated hydraulic conductivities for CYM-17N1 ranged from 5.1×10^{-5} to 1.2×10^{-4} cm/second. The average hydraulic conductivity for CYM-17N1 was calculated to be 8.6×10^{-5} cm/second (Table 4). These values are approximately an order of magnitude less than the vertically equivalent one-inch core analyzes performed by Goode (2.97×10^{-3} cm/second at 153 ft in CYM-17N1 and 1.0×10^{-2} cm/second at 150 ft in CYM-19H1), but they are probably representative of the entire saturated screened interval in each monitoring well.

Slug test results for the CYM-21D monitoring well calculated hydraulic conductivity of 1.0×10^{-4} cm/second in the deeper lacustrine sheet sand unit. This unit was deep and has a limited water column (approximately 8 feet) and therefore these slug test results may be questionable. It

appears suspicious that the calculated hydraulic conductivity for CYM-21D1 was more than an order of magnitude less than for the upper zones, when it appears similar in core samples. The slug test estimate for CYM-21D1 is also more than an order of magnitude less than laboratory testing of sand from the same zone.

A summary of slug test results in feet per minute and centimeters per second are presented in Table 4. Copies of slug test calculations and supporting equations are included in Appendix D.

4.5 Occurrence of Useable Groundwater

A review of the California Department of Water Resources database indicates that there were two historic agricultural wells situated approximately 4.5 miles east of the CYM-21D1 monitoring well. These water wells are located along the West Side Canal system, which supplies irrigation water to the southern San Joaquin Valley. Well information was retrieved from historical groundwater level data for all wells monitored by the Department of Water Resources Central and Northern Districts (DWR) and their cooperators. A summary of these wells follows.

1. 29S23E07Q001M (Sec7, 29S, 23E): 55 records (measurements) starting from 02-04-74 through 01-16-02.
2. 29S23E07H003M (Sec17, 29S, 23E): 63 records (measurements) starting from 10-02-69 through 09-23-02.

Copies of the DWR water well location map for the surrounding area and the water well data are included in Appendix E.

5 GROUNDWATER GEOCHEMISTRY

Groundwater samples collected from monitoring wells (CYM-19H1, CYM-17N1 and CYM-21D1) were analyzed for general mineral constituents, petroleum hydrocarbons, and stable isotopes of oxygen (O) and hydrogen (H) to evaluate groundwater in the vicinity of the VWDC Cymric facility. Groundwater that is assumed to occur naturally will be called "native". Oilfield water introduced to the Cymric area will be called "produced" water. Both native groundwater and produced water in this area of the southern San Joaquin Valley are known to be brackish in nature (Davis and Coplen 1989). Native groundwater chemistry in the Cymric area is not well documented as a result of few well completions and water quality analyses of the alluvial aquifers. It is possible that water quality in the alluvial aquifers across the area vary due to rapidly changing basin margin sediments and depositional environments.

It is the purpose of this report to review both the inorganic ion and isotopic geochemical data as produced water tracers. A description of the use of stable isotopes as geochemical tracers is included in Appendix F. The geochemical data review consisted of examining the data described in the following sub-sections and evaluation of their potential usefulness to monitor groundwater movement.

5.1 Inorganic Geochemistry Analysis

The principal ions that occur within the produced waters are Na and Cl, while those in the native groundwaters are Na/Ca and SO_4 . Of these major ions, Cl is the most conservative (undergoes the least water-soil/rock interactions and chemical reactions during groundwater movement) and thus the best for monitoring migration of the produced groundwater. Further characterization of groundwater movement and mixing using SO_4 and boron (B) concentrations may also be useful since they may be fairly conservative in the Cymric study area.

As noted, the pond water is brackish as shown on the Stiff and Piper diagrams, Figures 7 and 8. Pond water is enriched in the anion chloride, while the native water has higher sulfate concentrations (Table 5). This is typical for native groundwaters of the region (Davis and Coplen 1989). It appears that the native groundwater in this area has cations enriched in both sodium and calcium (CYM-21D1 sample, Table 5), while the major cation in pond water is sodium (Table 5 and Figures 7 and 8). An effect of pond water commingled with native groundwater is illustrated on the tri-linear anion portion of the Piper diagram (Figure 8). Pond water, CYM-17N1, and CYM-19H1 groundwater are enriched in chloride with respect to sulfate, while the opposite is true for the CYM-21D1 groundwater sample. All samples are depleted in bicarbonate with respect to the other major anions (chloride and sulfate, Figure 8).

Figure 9, a histogram of the indicator ions, displays trends of the indicator ions for each of the monitoring wells impoundment. Elevated concentrations of chloride, sodium and boron were detected in water collected from VWDC's McKittrick pond water, CYM-19H1, and CYM-17N1 as compared to CYM-21D1 (Figure 9). For example, chloride was detected at 4,520 mg/L in the pond, 4,120 mg/L in well CYM-19H1, 2,700 mg/L in well CYM-17N1, and 334 mg/L in well CYM-21D1. A higher ratio of sulfate to chloride was detected in the well CYM-21D1, which appears to be native groundwater from the deeper lacustrine sheet sand unit. The pond water had depressed sulfate concentration (170 mg/L). Results of the inorganic geochemical analyses are summarized in Table 5. Copies of laboratory analytical data are included in Appendix G.

5.2 Groundwater Monitoring via Inorganic Chemistry and Oxygen (O) and Hydrogen (H) Isotope Ratios

In the Cymric area, brackish produced water is disposed into surface percolation ponds, these waters infiltrate the vadose zone, and ultimately mix with native groundwater in the local aquifers. Although native waters are also brackish, they contain significantly different ion chemistries, and O and H isotope abundances from the produced waters. Native groundwaters

in the study area have distinct stable H isotope and O isotope abundances that vary little over time. Produced waters, on the other hand, have isotope abundances that are both variable and distinctly different from native groundwater. The nature and behavior of isotopes in water and their variations are explained in detail in Appendix F. These isotopes in water also behave conservatively, and therefore, allow for another method of monitoring in the study area. It is advantageous to use isotopic signatures of the produced water to monitor its movement through groundwater because the isotopes represent the *water* as it migrates and not ions or dissolved solids whose movement through soil may be attenuated or amplified. Stable isotopes of O and H are reported as per mil change of ^{18}O and ^2H from standard mean oceanic water (SMOW) or $\delta^{18}\text{O}$ and δD for oxygen and hydrogen, respectively (Appendix F).

At the VWDC Cymric facility, produced water is a by-product pumped from local petroleum reservoirs. In petroleum source zones, a high geothermal gradient is necessary to induce maturation of organic material into petroleum products: oil or natural gas. This geothermal heating simultaneously induces chemical reactions between the rocks and water within the source zone, including O and H isotopic exchanges. The heated water, which has undergone O and H isotopic exchanges, eventually migrates into a petroleum reservoir unit, where it may be produced. This causes the $\delta^{18}\text{O}$ and δD values of the petroleum reservoir waters to increase. Such is the case with the produced waters in the Cymric area: they have distinctly higher isotopic abundance than the native groundwater. Another cause of the high $\delta^{18}\text{O}$ and δD values in the pond water is evaporation fractionation, which the produced water undergoes in the ponds prior to entering the aquifers.

On a bilinear diagram of oxygen and hydrogen isotopic compositions, the VWDC's pond, the CYM-19H1, and the CYM-17N1 samples plot far to the right of the Meteoric Water Line, suggesting that water from monitoring wells CYM-19H1 and CYM-17N1 is similar to water from VWDC's pond facility (Figure 10). The oxygen and hydrogen isotopic composition of water from CYM-21D1 is more similar to the isotopic composition of meteoric water.

Groundwater samples collected from CYM-21D1 appear to be native water quality. Oxygen and hydrogen isotopic analytical data for water samples are summarized in Table 6.

5.3 Inorganic and Isotopic Geochemical Correlations

A similar investigation performed by Geomega at the VWDC Maricopa Flats facility, demonstrated that several of the chemically conservative inorganic constituents were positively correlated to stable isotopes of oxygen and hydrogen and could therefore be used as geochemical tracers to fingerprint water samples (Geomega 1999). On the basis of the Maricopa Flats study, chloride concentrations correlate especially well to $\delta^{18}\text{O}$ and δD . Thus, chloride may be regarded as the most conservative ion, and good for monitoring groundwater; it is the least likely to undergo exchange between the soil and groundwater along flow paths and over time in the Cymric study area. Chloride is also concentrated in produced water and a logical choice for monitoring the produced water emanating from the Cymric facility.

5.4 Petroleum Hydrocarbon Organic Constituents

All of the recently completed wells and a pond water sample were analyzed for the presence of organic petroleum derivatives. Water samples were analyzed for total petroleum hydrocarbons, diesel range (TPH) and for the presence of aromatic petroleum hydrocarbons benzene, toluene, ethylbenzene, and xylene (BTEX).

Detections of TPH and BTEX constituents were found just above the method detection limits for these compounds in the pond water sample (Table 7). A low level detection of TPH (3.9 mg/L) was found in monitoring well CYM-19H1. Additional sampling and analysis of these monitoring wells and ponds would be required to determine if these are laboratory induced positives, or truly representative of pond and groundwater chemistry in the area.

6 SUMMARY AND CONCLUSIONS

Valley Waste Disposal Company installed three monitoring wells in the alluvium as part of a hydrogeologic investigation to characterize the groundwater hydrology of the Cymric Study Area, adjacent to the VWDC Cymric facility. The data acquisition phase of the investigation involved the drilling of three boreholes to acquire core and geophysical logs of the alluvium, converting the boreholes to groundwater monitoring wells, collecting/analyzing groundwater samples, and performing slug tests on each of the three monitoring wells.

Silty clay layers within the shallower alluvial fan sequence act to perch groundwater in the Cymric area. Multi-perched water zones in the alluvial fan sequence encountered in borehole/monitoring wells CYM-17N1 and CYM-19H1 are apparent from air rotary drilling and geophysical log interpretation. Perched groundwater was sampled at monitoring well locations CYM-17N1 and CYM-19H1 in alluvial fan hydrostratigraphic units within 170 feet of the ground surface. Estimated hydraulic conductivities, calculated from slug test results, ranged from 3×10^{-3} to 2×10^{-4} cm/sec in this upper alluvial aquifer, which is consistent with literature values for sand and silty sand formations. Groundwater gradient and Darcy velocity could not be determined for the shallower perched aquifer, since there were not three wells completed in a correlative aquifer unit.

A deeper, thin lacustrine sheet sand hydrostratigraphic unit was encountered at well location CYM-21D. First groundwater in the CYM-21D1 was detected at 286 feet in the deeper lacustrine unit while drilling with air rotary methods in a lower, unconfined aquifer near the top of the CCE. This was the only well completed in the lower lacustrine sheet sand unit. Slug test results for well CYM-21D1 are suspect due to the short water column encountered in the well bore. The CYM-21D was devoid of groundwater in the upper alluvial fan hydrostratigraphic equivalents where water was detected in CYM-17N1 and CYM-19H1. Groundwater gradient and Darcy velocity for this deeper aquifer could not be determined from the data collected,

since only one well evaluated groundwater in this unit.

Groundwater samples were collected from the three monitoring wells and a water sample was taken from a VWDC McKittrick facility pond cell. Samples were analyzed for general mineral constituents, oxygen and hydrogen isotopic composition, and petroleum hydrocarbon derivatives to evaluate groundwater quality adjacent to the VWDC McKittrick pond system. Analytical results of groundwater samples indicate that well locations CYM-19H1 and CYM-17N1 display constituents of produced water. Groundwater samples collected from CYM-19H1 and CYM-17N1 had chloride concentrations at 4,120 mg/L and 2,700 mg/L, respectively. Monitoring well CYM-21D1 appears to have encountered native groundwater (chloride = 343 mg/L), unaffected by produced water. Stable isotopes analyses also demonstrate a mixture of native groundwater and produced water in the shallow perched aquifers of wells CYM-17N1 and CYM-19H1. The stable isotopes analysis of water sampled from the CYM-21D1 well indicates that this deeper lacustrine sand unit contains native groundwater.

It appears that produced water from oilfield disposal management activities at the Cymric Field is present 0.75 miles northeast of the pond system in monitoring well CYM-17N1, and may be constrained in the shallower perched aquifer unit. The lateral and vertical extent of the produced water has not been determined by this investigation. Additional field investigation is recommended to better characterize the hydrogeology of the Cymric area, to determine the geochemistry of native water in the shallow alluvial units, and to delineate the extent of produced water in the subsurface. Locating and drilling additional monitoring wells in the Cymric Study Area may be challenging because they will likely be positioned in a protected wildlife habitat area.

7 REFERENCES

- Bouwer, H. and R.C. Rice. 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resource Research, vol. 12, no. 3, pp. 423-428.
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- Geomega, Inc. 2002b. Phase II Hydrogeologic Characterization Report, Valley Waste Disposal Company, Maricopa Flats Area. Prepared for VWDC, October 24, 2002.
- RWQCB, April 10, 2001. Letter from Mr. James K. Dowdall and Mr. Shelton R. Gray to Mr. Larry Bright, Valley Waste Disposal Company.
- Strata Geophysical, Inc. November 15, 2000. Electrical Geophysical Survey, Valley Waste Disposal Company, Percolation Ponds McK1 & McK 1-3, Kern County, California.

Tables

TABLE 1

SUMMARY OF BOREHOLE INFORMATION

VALLEY WASTE DISPOSAL COMPANY
CYMRIC FIELD STUDY AREA
KERN COUNTY, CALIFORNIA

Borehole Number	Date Drilled	Surveyed Surface Elevation (feet amsl)	Total Depth (feet bgs)	Depth to Water (feet bgs)	Water Table Elevation (feet amsl)
CYM-19H1	11/06/02 to 11/09/02	469	245	129	340
CYM-17N1	11/19/02 to 11/22/02	451	240	140	311
CYM-21D1	11/11/02 to 11/19/02	427	300	286	141

amsl = above sea level

bgs = below ground surface

TABLE 2

SUMMARY OF MONITORING WELL CONSTRUCTION

VALLEY WASTE DISPOSAL COMPANY
CYMRIC FIELD STUDY AREA
KERN COUNTY, CALIFORNIA

Monitoring Well	Date Installed	Surveyed Surface Elevation (feet amsl)	Steel Casing Elevation (feet amsl)	Total Depth of Well Casing (feet bgs)	Depth to Water (feet bgs)	Screened Interval (feet bgs)	Well Construction Material
CYM-19H1	11/06/02 to 11/09/02	469	472	245	129	115 to 155	5-inch Sch 80 PVC 0.020 slot screen
CYM-17N1	11/19/02 to 11/22/02	451	443	240	140	105 to 165	5-inch Sch 80 PVC 0.020 slot screen
CYM-21D1	11/11/02 to 11/19/02	427	423	300	286	274 to 294	5-inch Sch 80 PVC 0.020 slot screen

amsl = above sea level

bgs = below ground surface

TABLE 3

WHOLE CORE TESTING SUMMARY

VALLEY WASTE DISPOSAL COMPANY
CYMRIC FIELD STUDY AREA
KERN COUNTY, CALIFORNIA

Test Location	Depth (feet)	Horz. Ka(md)	Hydraulic Conductivity (cm/second)	Description
CYM-17N1	152.8	3073.9	2.97E-03	Sand
CYM-17N1	180.1	15.31	1.48E-05	Silt
CYM-17N1	210.0	5073.51	4.90E-03	Sand
CYM-17N1	239.9	29.59	2.86E-05	Silt
CYM-19H1	150.4	10305.41	9.96E-03	Sand
CYM-19H1	185.0	20361.82	1.97E-02	Sand
CYM-19H1	220	2513.07	2.43E-03	Sand
CYM-21D1	224.9	2622.62	2.53E-03	Sand
CYM-21D1	269.9	7.09	6.85E-06	Silt
CYM-21D1	280	1864.92	1.80E-03	Sand

TABLE 4

SUMMARY OF SLUG TEST RESULTS

VALLEY WASTE DISPOSAL COMPANY
CYMRIC FIELD STUDY AREA
KERN COUNTY, CALIFORNIA

Test Location	Date	Hydraulic Conductivity (cm/second)
CYM-17N1a	11/26/02	5.1E-05
CYM-17N1b	11/26/02	1.2E-04
CYM-17N1 (average)	11/26/02	8.6E-05
CYM-19H1a	11/26/02	1.8E-03
CYM-19H1b	11/26/02	1.6E-03
CYM-19H1 (average)	11/26/02	1.7E-03
CYM-21D1	11/26/02	1.0E-04

TABLE 5

SUMMARY OF INORGANIC GEOCHEMISTRY ANALYTICAL DATA

VALLEY WASTE DISPOSAL COMPANY
CYMRIC FIELD STUDY AREA
KERN COUNTY, CALIFORNIA

CONSTITUENTS	Cymric Pond 1/14/03	CYM-19H1 11/25/02	CYM-17N1 11/26/02	CYM-21D1 11/24/02
Calcium (mg/L)	120	760	810	100
Magnesium (mg/L)	66	260	330	88
Sodium (mg/L)	2,900	2,500	1,300	170
Potassium (mg/L)	55	12	8	2.1
Total Cations (meg/L)	137	170	123	20.1
Hydroxide (mg/L)	<	ND	ND	ND
Carbonate (mg/L)	<	ND	ND	ND
Bicarbonate (mg/L)	1,500	600	400	140
Chloride (mg/L)	4,520	4,120	2,700	334
Sulfate (mg/L)	170	2,420	2,090	423
Nitrite/Nitrite as N (mg/L)	<	22	9.0	0.85
Nitrate/Nitrite as NO ₃ (mg/L)	<	95.5	40	3.8
Total Anions (meg/L)	155	178	127	20.6
pH	8	7.20	7.58	8.03
Electrical Conductivity @ 25°C (umhos/cm)	14,600	15,600	10,900	1,970
Hardness as CaCO ₃ (mg/L)	570	2,990	3,360	624
Sodium Adsorption Ratio (SAR)	52	20	9.6	3.0
Adjusted SAR	151	65	30	6.7
Extractable Sodium Percentage (ESP)	43	22	11	3.1
pHc	7	6.2	6.3	7.2
Gypsum Requirement #100% Gyp/Hr/100gal/Min	53	ND	ND	ND
Dissolved Boron (mg/L)	54	36	20	2.5
Calculated TDS (mg/L)	8,500	10,500	7,450	1,200

TABLE 6

**OXYGEN AND HYDROGEN ISOTOPIC
COMPOSITION OF WATER SAMPLES**

VALLEY WASTE DISPOSAL COMPANY

KERN COUNTY, CALIFORNIA

Sample Location	δO^{18}	δD	δD duplicate
CYM-19H1	-4.5	-55	-54
CYM-17N1	-6.0	-65	-64
CYM-21D1	-11.6	-93	-91
Pond Water	-5.1	-60	-58

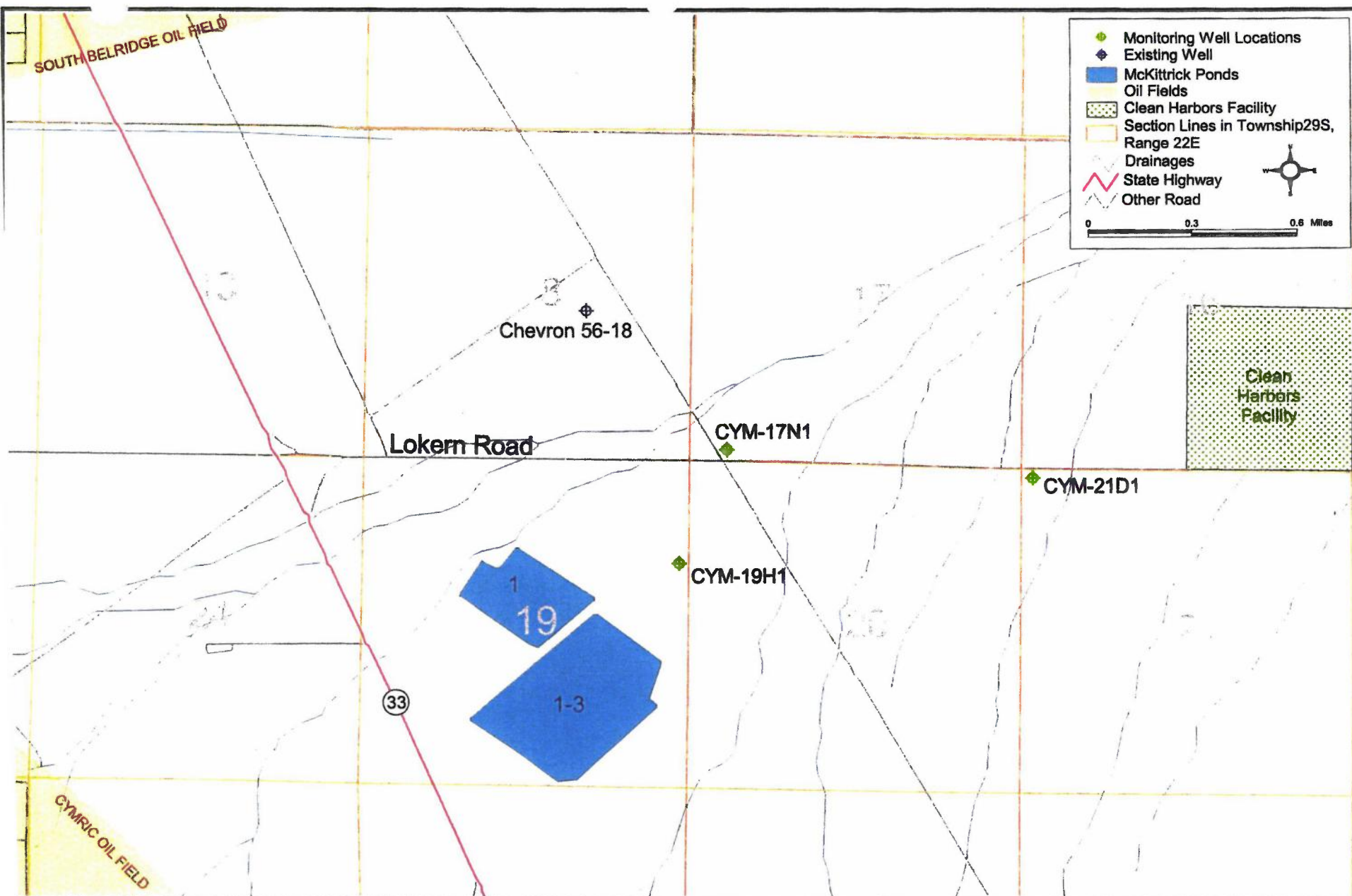
TABLE 7

ORGANIC GEOCHEMISTRY ANALYTICAL DATA

VALLEY WASTE DISPOSAL COMPANY
MARICOPA FLATS STUDY AREA
KERN COUNTY, CALIFORNIA

Well ID	TPH Crude Oil (mg/L)	Benzene (µg/L)	Ethylbenzene (µg/L)	Toluene (µg/L)	Total Xylenes (µg/L)
CYM-19H1	3.9	<	<	<	<
CYM-17N1	<	<	<	<	<
CYM-21D1	<	<	<	<	<
Pond Water	3.8	0.60	ND	0.31	2.6

Figures



Generation
Date:
3/16/04

Figure 1. Location map, Valley Waste Disposal Company, Cymric Field.



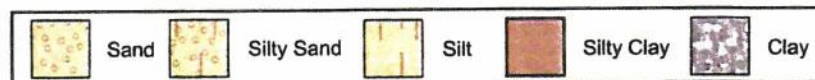
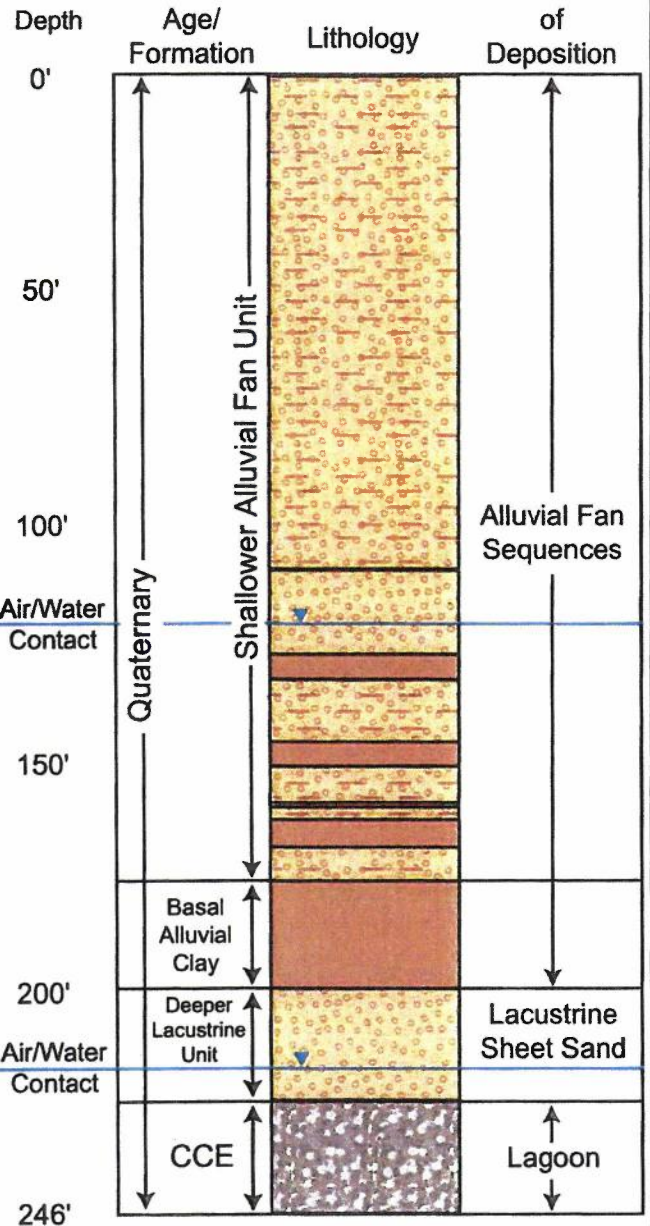
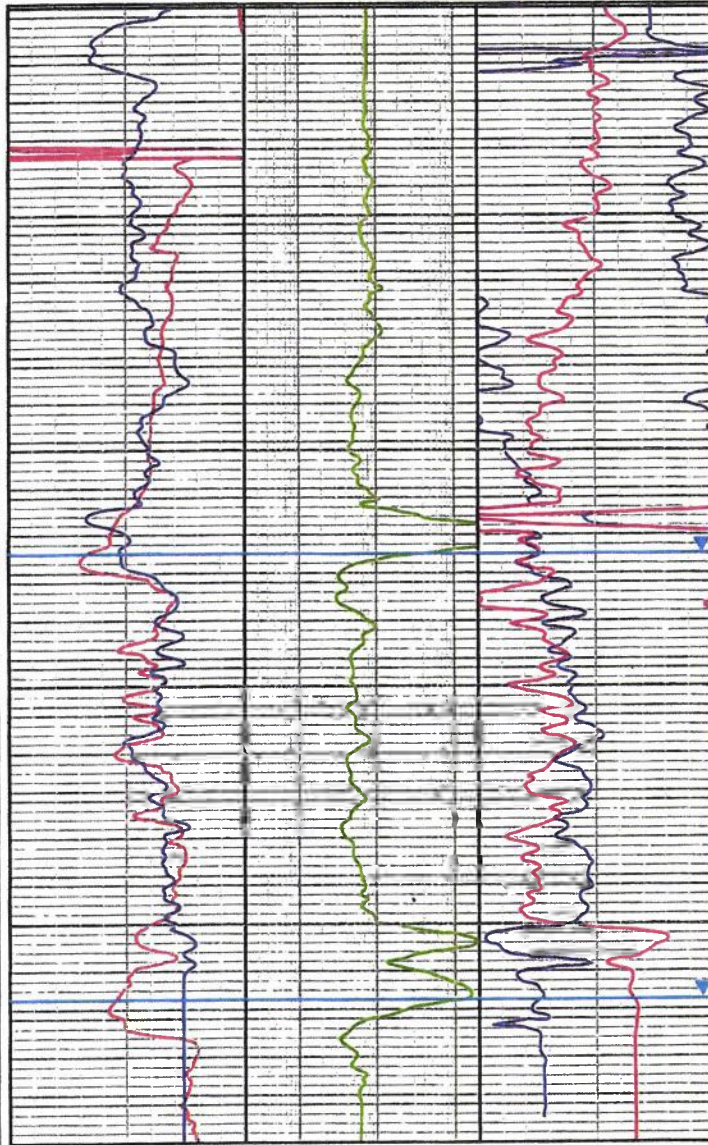
Geophysical Type Log

Stratigraphic Section

Gamma Ray + SP Induction (AHT90) Neutron Porosity
Formation Density

-80 SP (MV) 20 0.6 TNPH (porosity) 0

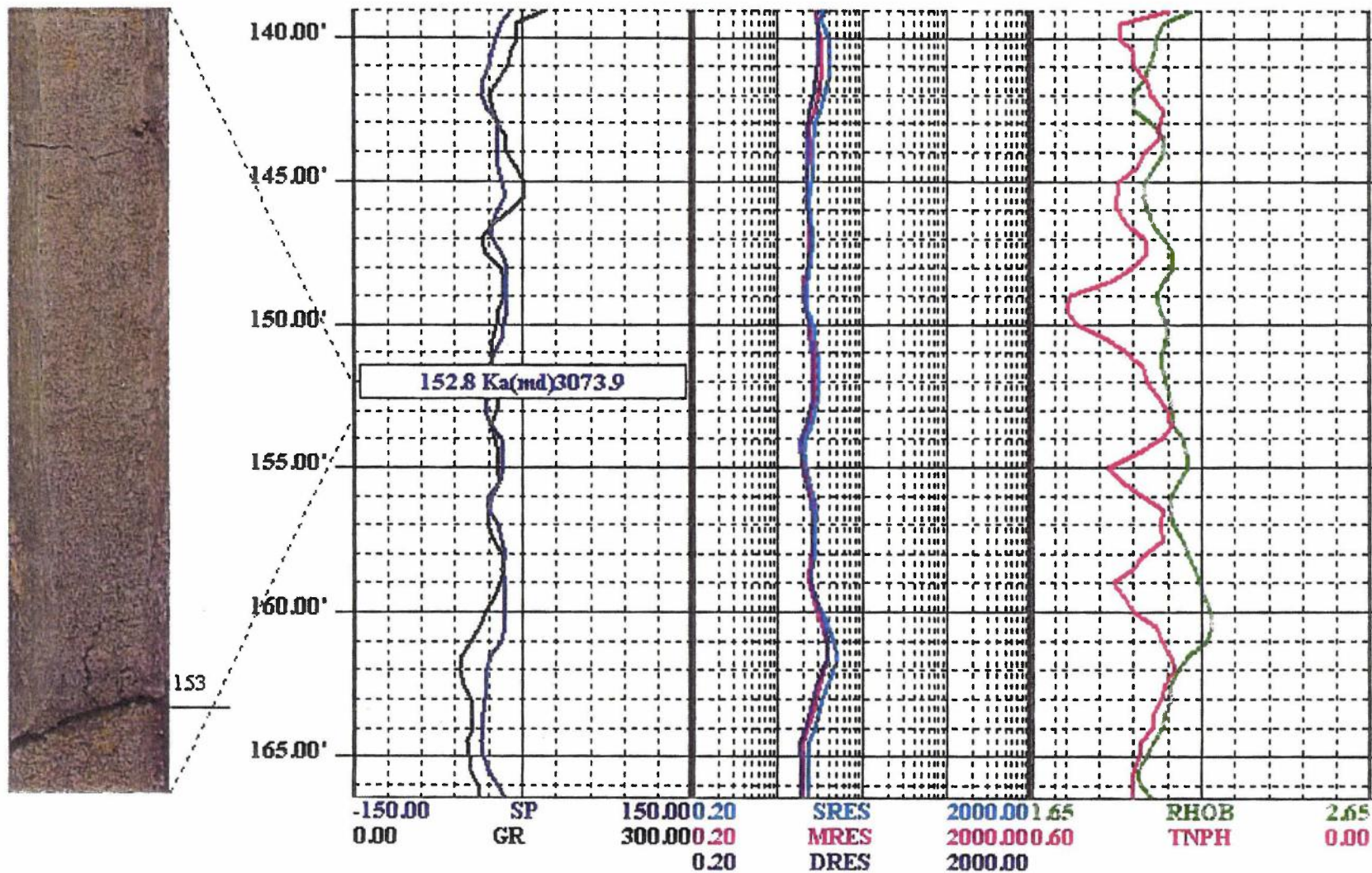
0 GR (GAPI) 200 0.2 OHMM 200 1.65 RHOZ (G/cm³) 2.65



Generation
Date:
3/16/04

Figure 2. Type log and stratigraphic section, Cymric Field study area.

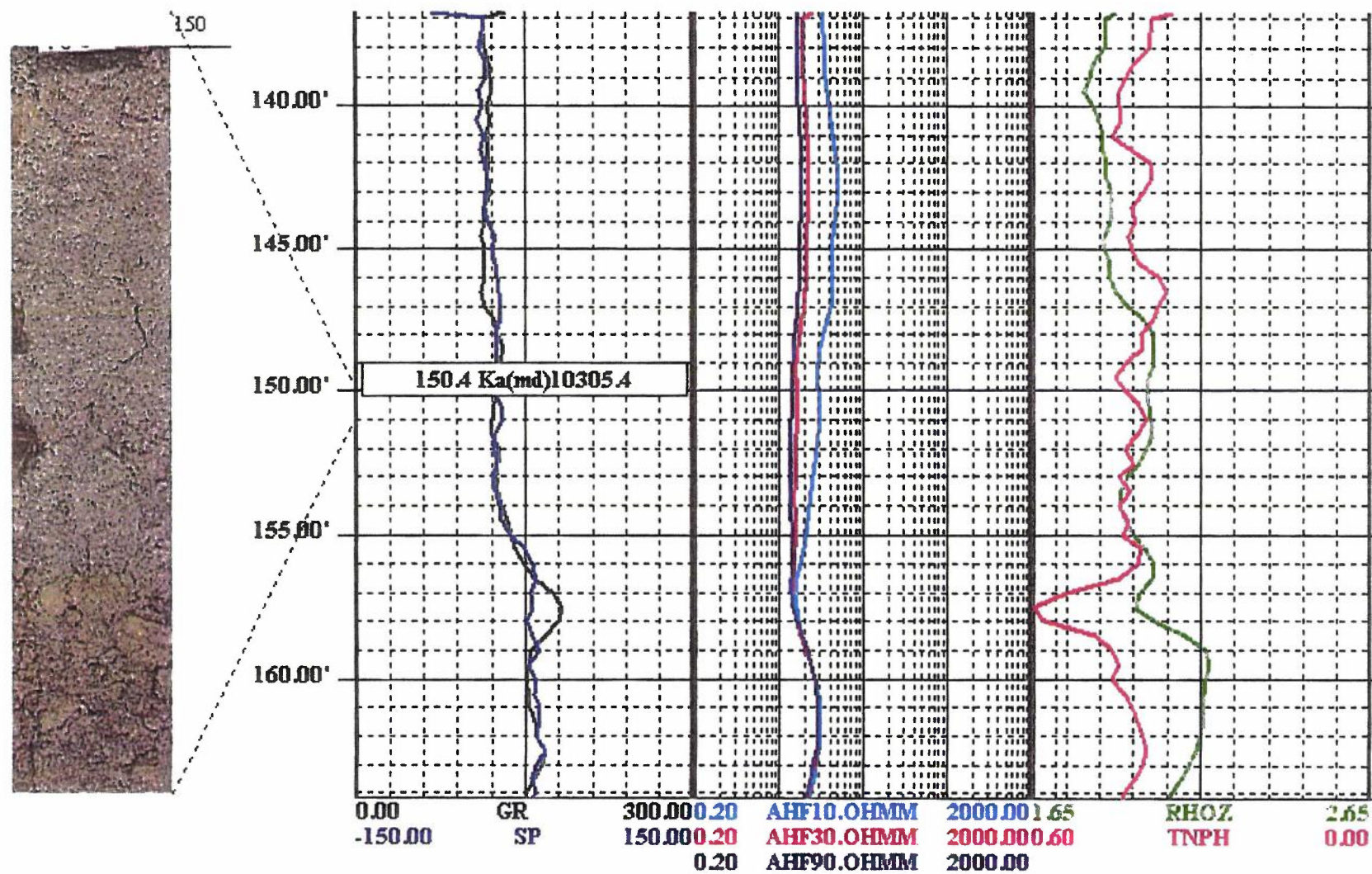




Generation
Date:
3/16/04

Figure 3. Core and log response for typical silty sand.

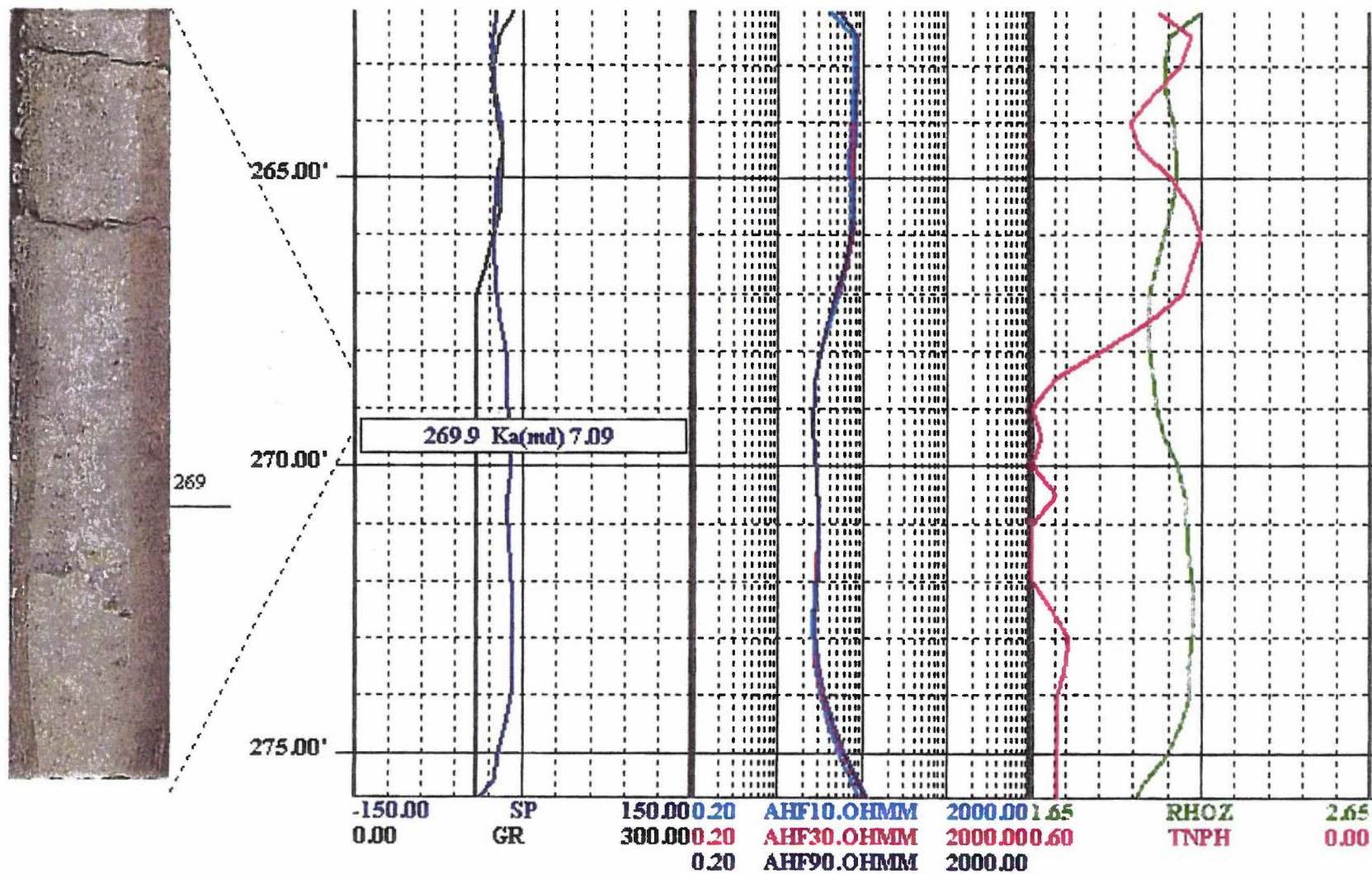




Generation
Date:
3/16/04

Figure 4. Core and log response for typical alluvial sand.

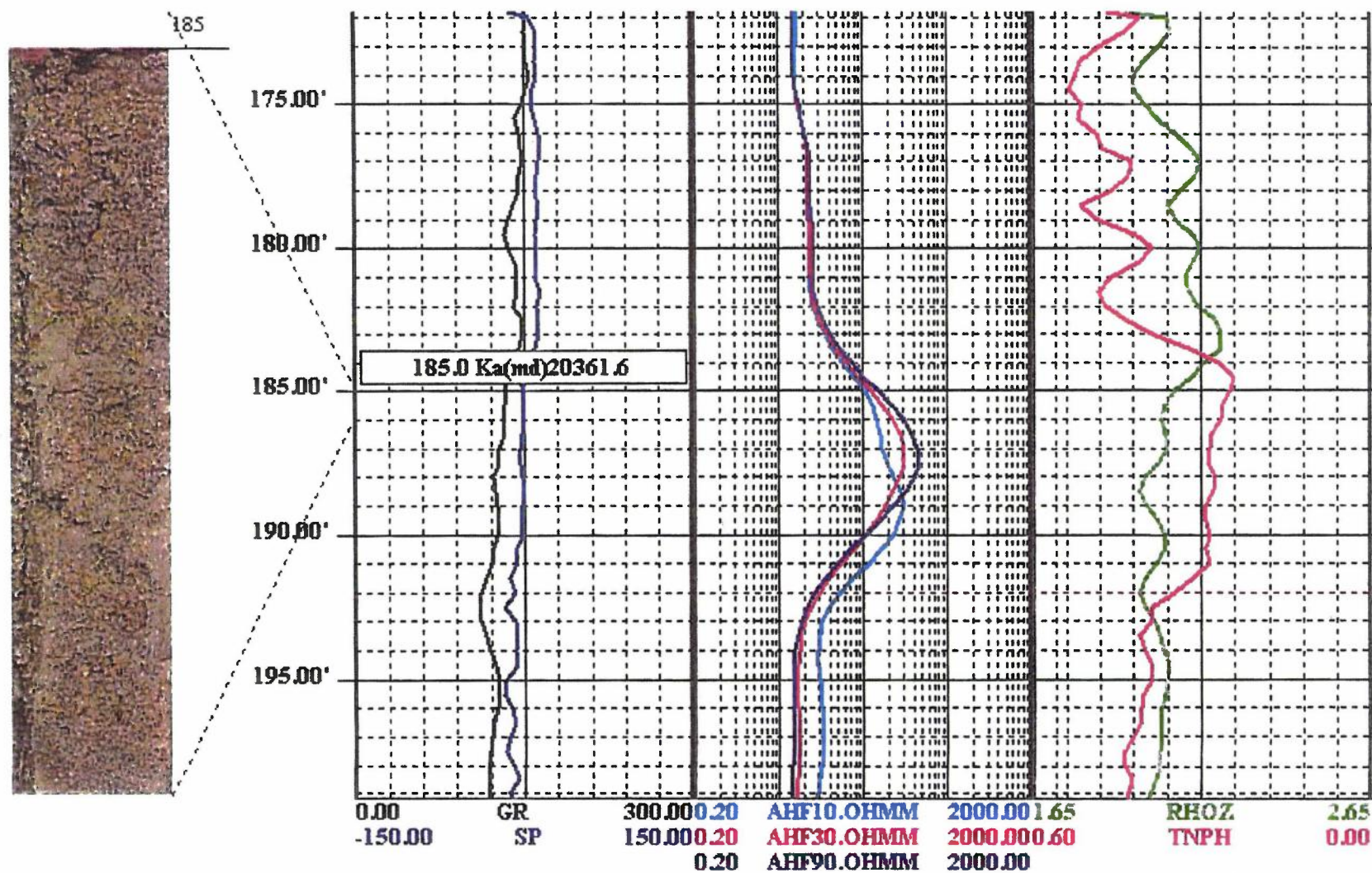

Geomega



Generation
Date:
3/16/04

Figure 5. Core and log response for typical silty clay.

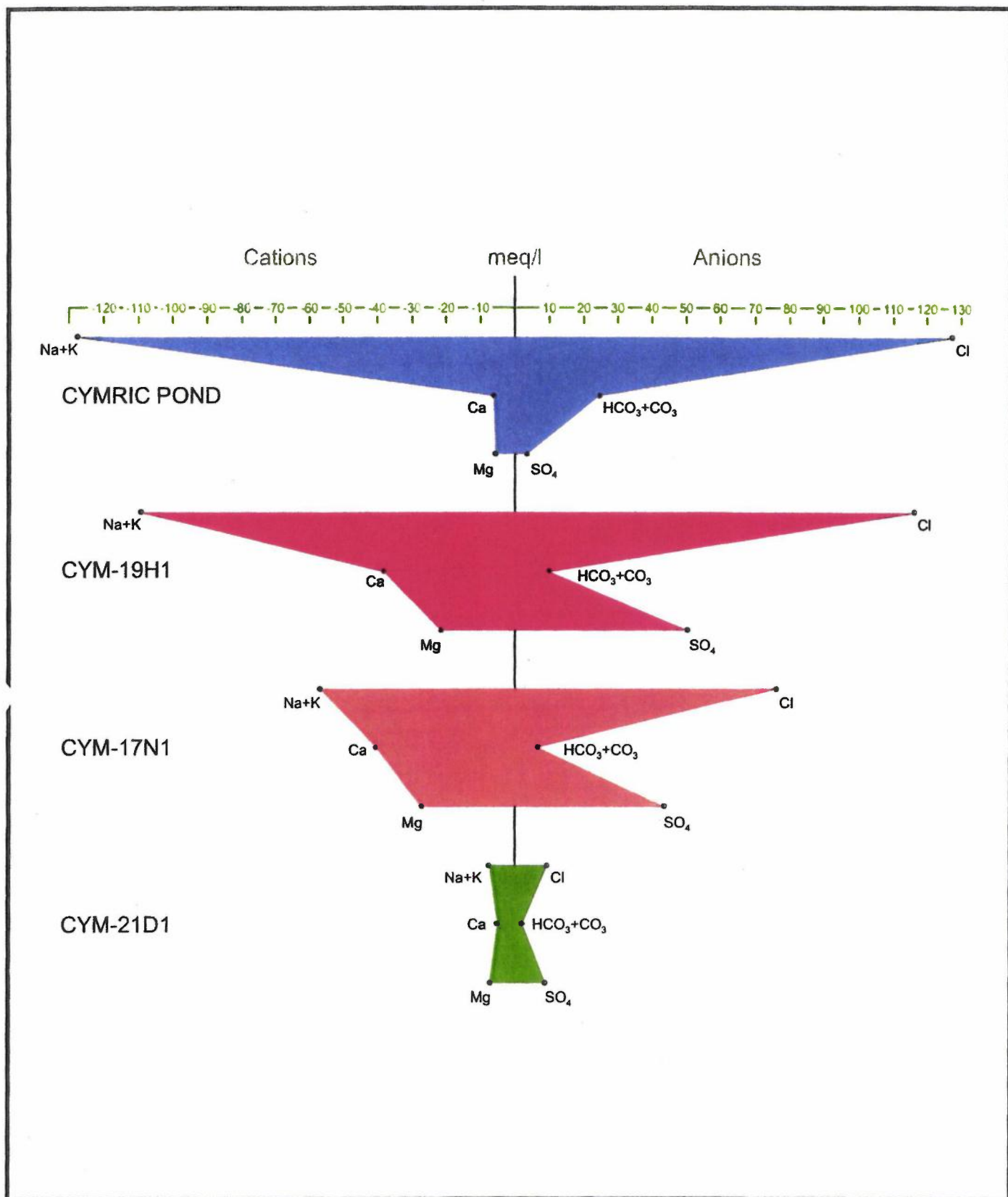

Geomega



Generation
Date:
3/16/04

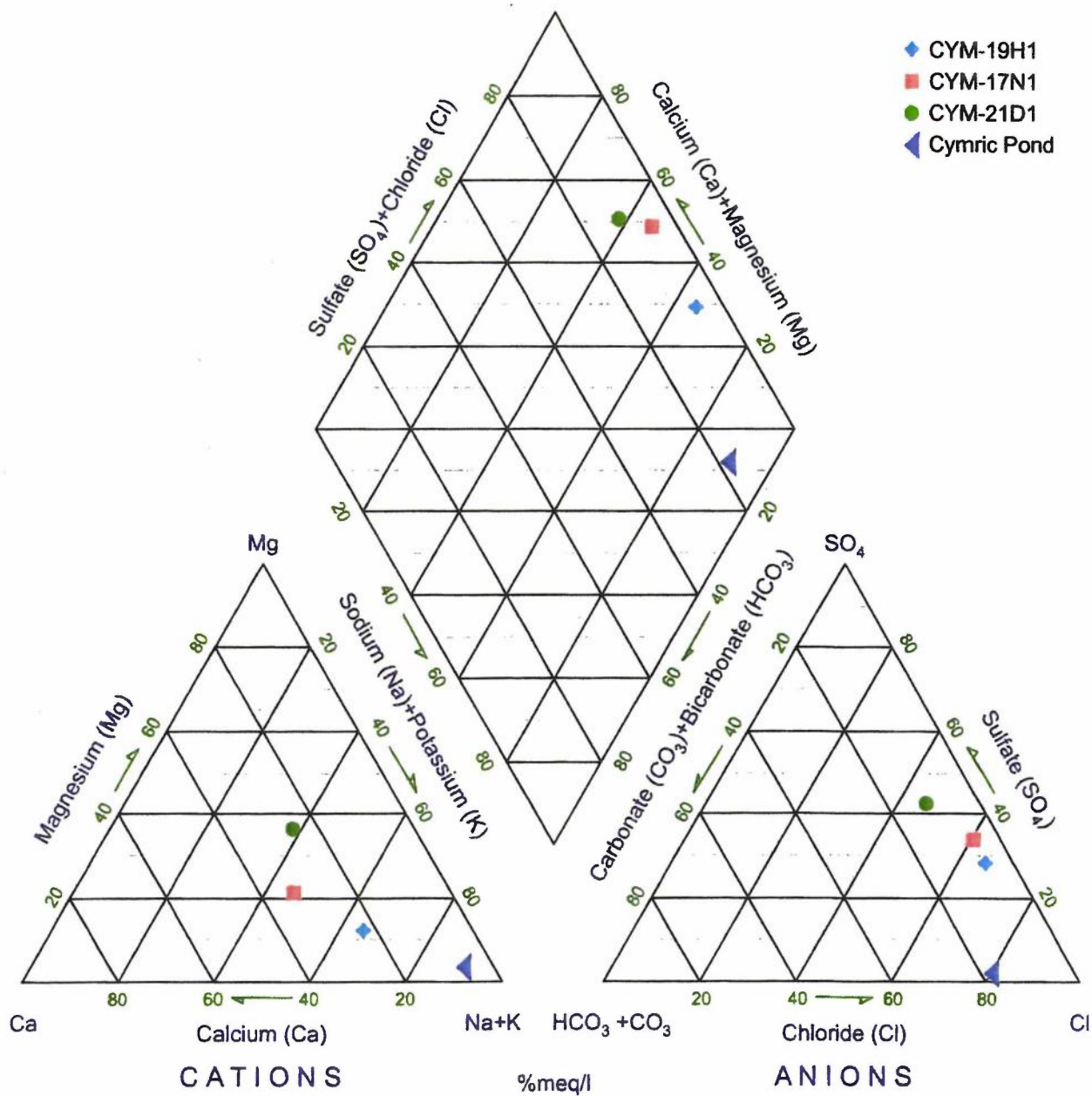
Figure 6. Core and log response for typical lacustrine sand.





Generation
Date:
3/16/04

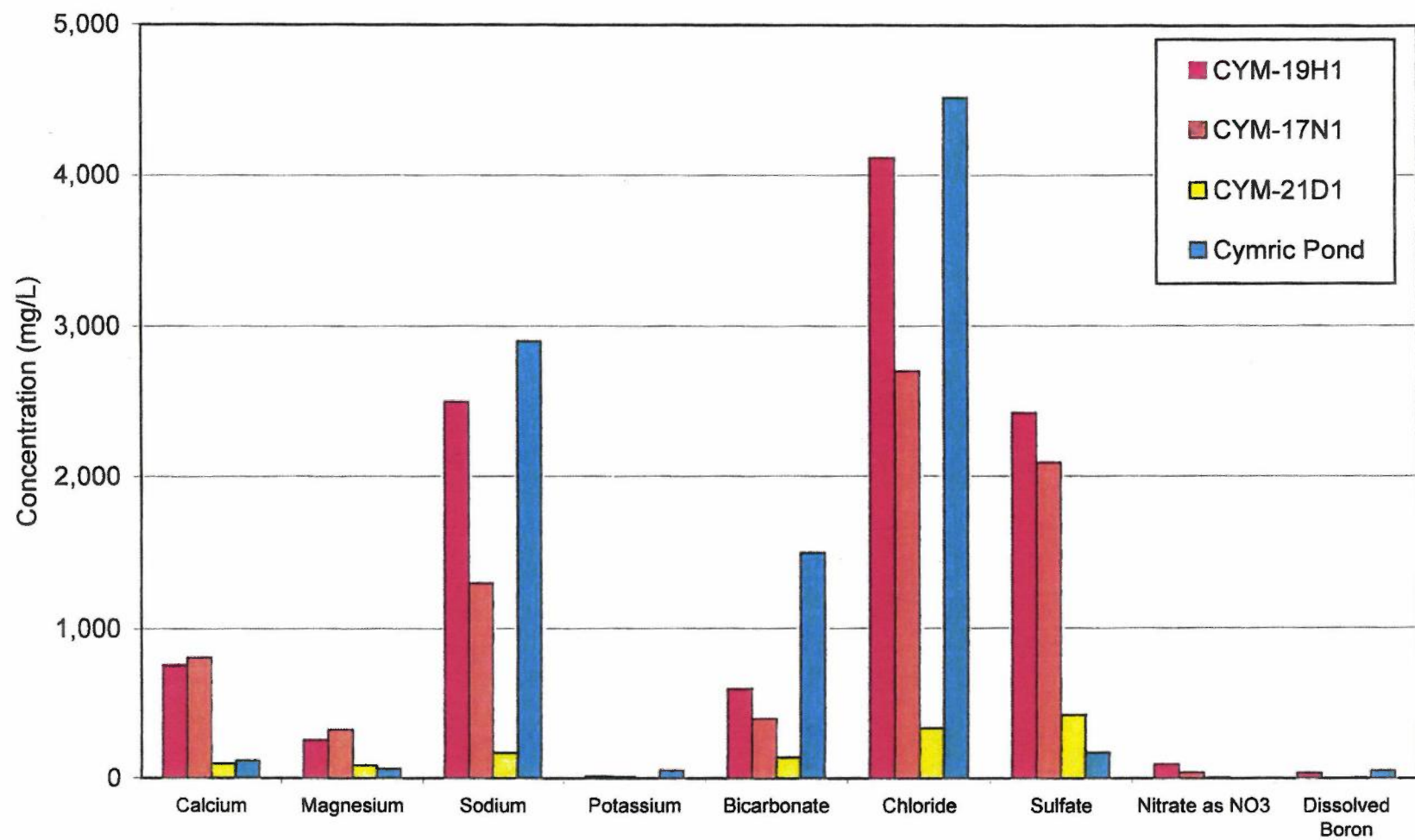
Figure 7. Stiff diagram of water samples,
Cymric Field.



Generation
Date:
3/16/04

Figure 8. Piper diagram of water samples,
Cymric Field.

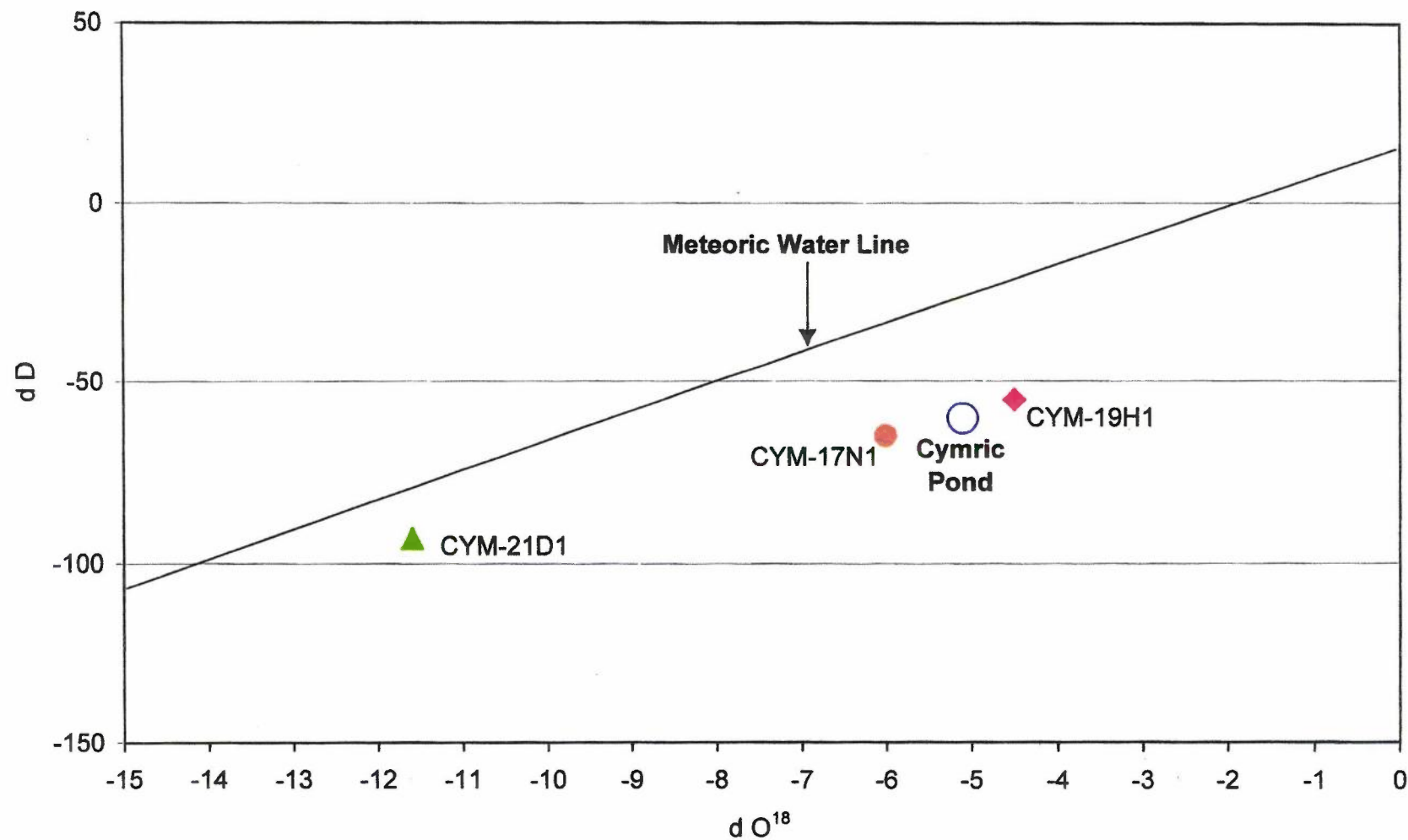




Generation
Date:
3/16/04

Figure 9. Select geochemical ions detected in water samples.



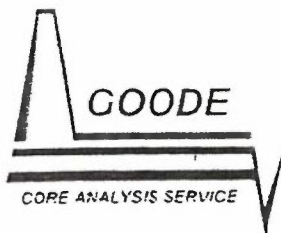


Generation
Date:
3/16/04

Figure 10. Oxygen and hydrogen isotopic compositions.



Appendix A



1400 Easton Drive, Suite 111 • Bakersfield, CA 93309 • (661) 322-5540 • Fax (661) 322-5576

March 6, 2003

Mr. Larry Bright
Valley Waste Disposal Co.
1400 Easton Dr. Suite 139B
Bakersfield, CA 93309

Subject: Core Analysis Data
Well: 19H-1
Cymric Area
Kern, CA
File No.: 102274

Dear Mr Bright

Conventional cores recovered from the subject well were packaged and transported to our laboratory by Chevron USA personnel. The results of these measurements are presented in the accompanying report.

The cores were delivered to Goode Core Analysis and refrigerated in boxes with about 10 feet per box. The cores were photographed for presentation with our Core Viewer. Photographs under white light are presented with one box per page.

Selected depths were chosen for petrophysical testing. Sample locations selected were arbor cut or drilled using liquid nitrogen as the bit coolant. Samples were encased in sleeves with 100 mesh end screens to hold the sample intact. The sleeves were seated to the sample by applying a pressure 400 psig. Weight difference determined saturations. Prior to measurement of porosity and permeability to air, the samples were dried at 235 degrees Fahrenheit. Porosity was determined by Boyle's Law method using helium as the gaseous medium. Pore volume and permeability measurements were made with a confining pressure of 250 psig. The analysis procedures are noted on the data pages.

Grain size measurements were determined on each sample. The dried sample was reduced to grain size and subsequently passed through a set of Tyler mesh screens. Percent weight and cumulative weight percent are presented in both tabular and graphical form.

We are pleased to have performed this service and trust we will be called upon again in the future.

Very Truly Yours,

GOODE CORE ANALYSIS SERVICE

A handwritten signature in dark ink, appearing to read 'Bryan A. Bell', is written over the company name.

Bryan A. Bell

Distribution: 3 copies data, Invoice: Addressee
1 copy data, 1 Set of Photographs, 1 Core Viewer CD: Jeff Anderson at Geomega Inc.

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Disposal Co.

Well: 19H-1

Field: Cymric Area

County, St: Kern County, CA

File No.: 102274

API No.:

Date: 3/4/03

Core Type: Conventional Cores

DEPTH	Horz. Ka(md)	Description
150.4	10305.41	Sd ltan vf-vcgr mica no stn no flor
185.0	20361.82	Sd ltan vf-vcgr mica no stn no flor
220.0	2513.07	Sd ltan vf-vcgr slsly mica no stn no flor

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.

File No: 102274

Well: 19H-1

Sample ID: Conv. Cores

Field: N/A

SIEVE ANALYSIS

Screen Weights

Opening (Inches)	0.1850	0.1310	0.0930	0.0650	0.0460	0.0328	0.0232	0.0164	0.0116	0.0082	0.0058	0.0041	0.0029	0.0021		Total
Tyler Mesh Size	4	6	8	12	16	20	28	35	48	65	100	150	200	270	pan	Weight
Well/Depth																
150.4	0.000	0.000	0.000	0.148	0.477	1.187	1.479	2.126	3.298	2.420	0.660	0.462	0.266	0.264	0.300	13.087
185.0	0.000	0.155	0.273	0.717	2.578	3.232	3.241	2.624	1.533	1.237	0.631	0.563	0.338	0.349	0.485	17.956
220.0	1.026	0.782	0.735	1.639	3.018	3.025	3.146	2.582	2.025	2.022	1.431	1.184	0.691	0.745	1.395	25.446

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
Well: 19H-1
Field: N/A

File No: 102274

Sample ID: Conv. Cores

SIEVE ANALYSIS

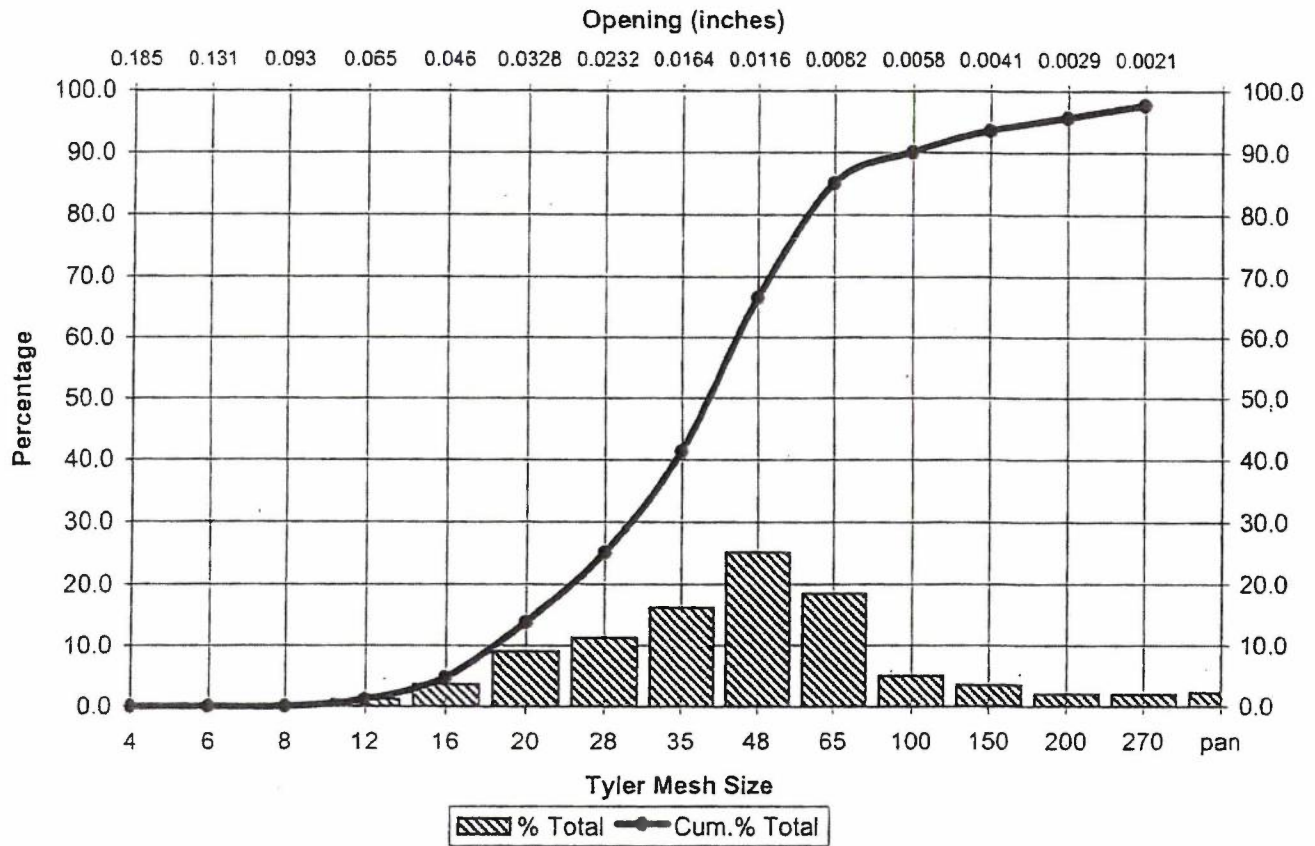
Opening (Inches) Tyler Mesh Size Well/Depth	Percent Weight															Total Weight
	0.1850 4	0.1310 6	0.0930 8	0.0650 12	0.0460 16	0.0328 20	0.0232 28	0.0164 35	0.0116 48	0.0082 65	0.0058 100	0.0041 150	0.0029 200	0.0021 270	pan	
150.4	0.0	0.0	0.0	1.1	3.6	9.1	11.3	16.2	25.2	18.5	5.0	3.5	2.0	2.0	2.3	13.087
185.0	0.0	0.9	1.5	4.0	14.4	18.0	18.0	14.6	8.5	6.9	3.5	3.1	1.9	1.9	2.7	17.956
220.0	4.0	3.1	2.9	6.4	11.9	11.9	12.4	10.1	8.0	7.9	5.6	4.7	2.7	2.9	5.5	25.446

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
 Cell: 19H-1
 Field: N/A

File No: 102274
 Sample ID: Conv. Cores
 Depth: 150.4

SIEVE ANALYSIS



Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	0.00	0.0	0.0	10	0.0384
Gran.	6	0.131	0.00	0.0	0.0	20	0.0276
	8	0.093	0.00	0.0	0.0	30	0.0212
V.Coarse	12	0.065	0.15	1.1	1.1	40	0.0170
	16	0.046	0.48	3.6	4.8	50	0.0148
Coarse	20	0.0328	1.19	9.1	13.8	60	0.0129
	28	0.0232	1.48	11.3	25.1	70	0.0110
Medium	35	0.0164	2.13	16.2	41.4	80	0.0091
	48	0.0116	3.30	25.2	66.6	90	0.0059
Fine	65	0.0082	2.42	18.5	85.1		
	100	0.0058	0.66	5.0	90.1		
V. Fine	150	0.0041	0.46	3.5	93.7		
	200	0.0029	0.27	2.0	95.7		
Silt	270	0.0021	0.26	2.0	97.7		
	pan		0.30	2.3			

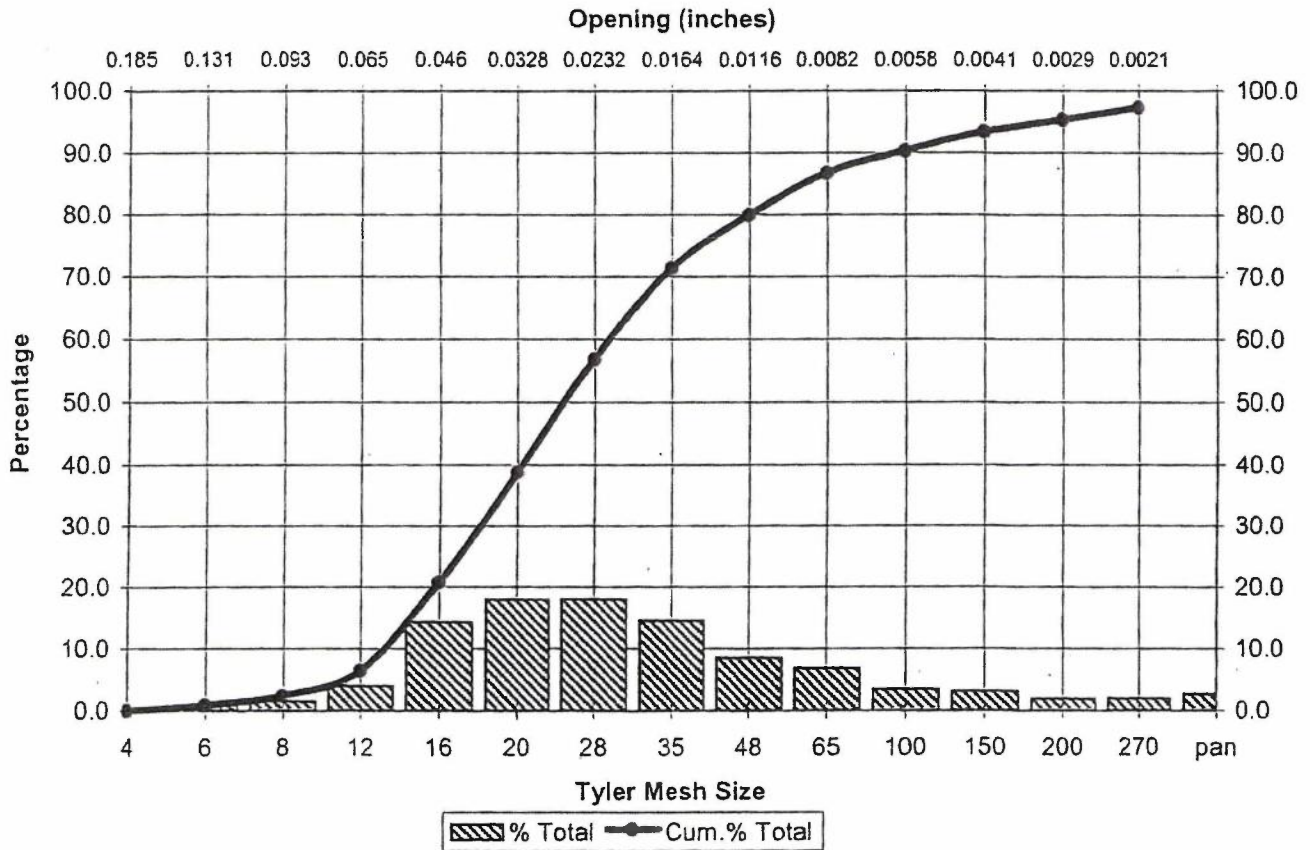
Totals 13.09 100.0

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
 ell: 19H-1
 Field: N/A

File No: 102274
 Sample ID: Conv. Cores
 Depth: 185

SIEVE ANALYSIS



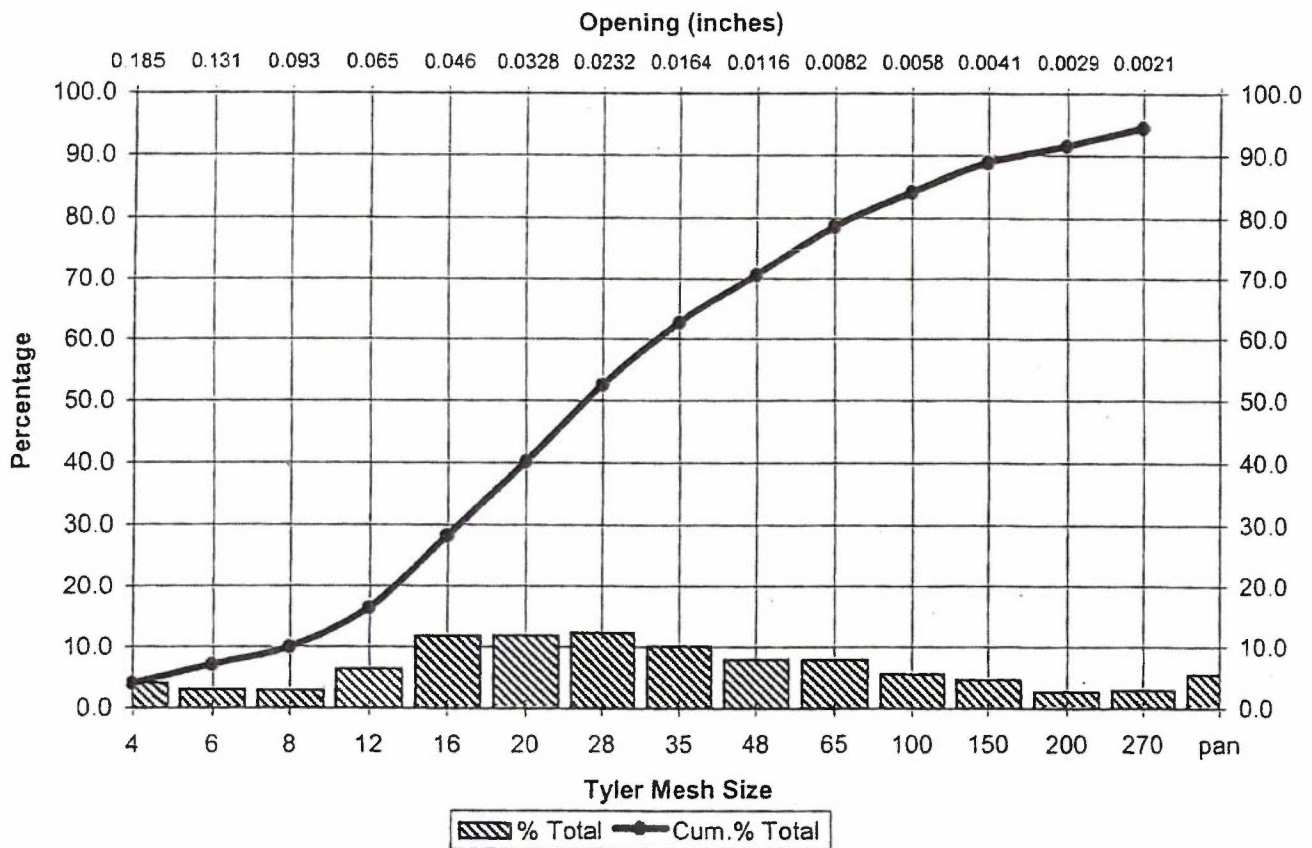
Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	0.00	0.0	0.0	10	0.0602
Gran.	6	0.131	0.16	0.9	0.9	20	0.0470
	8	0.093	0.27	1.5	2.4	30	0.0392
V.Coarse	12	0.065	0.72	4.0	6.4	40	0.0321
	16	0.046	2.58	14.4	20.7	50	0.0268
Coarse	20	0.0328	3.23	18.0	38.7	60	0.0217
	28	0.0232	3.24	18.0	56.8	70	0.0170
Medium	35	0.0164	2.62	14.6	71.4	80	0.0116
	48	0.0116	1.53	8.5	79.9	90	0.0060
Fine	65	0.0082	1.24	6.9	86.8		
	100	0.0058	0.63	3.5	90.3		
V. Fine	150	0.0041	0.56	3.1	93.5		
	200	0.0029	0.34	1.9	95.4		
Silt	270	0.0021	0.35	1.9	97.3		
	pan		0.49	2.7			
Totals			17.96	100.0			

GOODE CORE ANALYSIS SERVICE

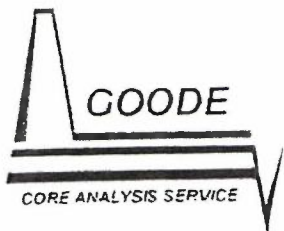
Company: Valley Waste Corp.
 Il: 19H-1
 Field: N/A

File No: 102274
 Sample ID: Conv. Cores
 Depth: 220

SIEVE ANALYSIS



Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	1.03	4.0	4.0	10	0.0930
Gran.	6	0.131	0.78	3.1	7.1	20	0.0593
	8	0.093	0.74	2.9	10.0	30	0.0441
V.Coarse	12	0.065	1.64	6.4	16.4	40	0.0330
	16	0.046	3.02	11.9	28.3	50	0.0252
Coarse	20	0.0328	3.03	11.9	40.2	60	0.0182
	28	0.0232	3.15	12.4	52.5	70	0.0120
Medium	35	0.0164	2.58	10.1	62.7	80	0.0076
	48	0.0116	2.03	8.0	70.7	90	0.0036
Fine	65	0.0082	2.02	7.9	78.6		
	100	0.0058	1.43	5.6	84.2		
V. Fine	150	0.0041	1.18	4.7	88.9		
	200	0.0029	0.69	2.7	91.6		
Silt	270	0.0021	0.74	2.9	94.5		
	pan		1.40	5.5			
Totals			25.45	100.0			



1400 Easton Drive, Suite 111 • Bakersfield, CA 93309 • (661) 322-5540 • Fax (661) 322-5576

March 4, 2003

Mr. Larry Bright
Valley Waste Disposal Co.
1400 Easton Dr. Suite 139B
Bakersfield, CA 93309

Subject: Core Analysis Data
Well: 17N-1
Cymric Area
Kern, CA
File No.: 102299

Dear Mr Bright

Conventional cores recovered from the subject well were packaged and transported to our laboratory by Chevron USA personnel. The results of these measurements are presented in the accompanying report.

The cores were delivered to Goode Core Analysis and refrigerated in boxes with about 10 feet per box. The cores were photographed for presentation with our Core Viewer. Photographs under white light are presented with one box per page.

Selected depths were chosen for petrophysical testing. Sample locations selected were arbor cut or drilled using liquid nitrogen as the bit coolant. Samples were encased in sleeves with 100 mesh end screens to hold the sample intact. The sleeves were seated to the sample by applying a pressure 400 psig. Weight difference determined saturations. Prior to measurement of porosity and permeability to air, the samples were dried at 235 degrees Fahrenheit. Porosity was determined by Boyle's Law method using helium as the gaseous medium. Pore volume and permeability measurements were made with a confining pressure of 250 psig. The analysis procedures are noted on the data pages.

Grain size measurements were determined on each sample. The dried sample was reduced to grain size and subsequently passed through a set of Tyler mesh screens. Percent weight and cumulative weight percent are presented in both tabular and graphical form.

We are pleased to have performed this service and trust we will be called upon again in the future.

Very Truly Yours,

GOODE CORE ANALYSIS SERVICE

A handwritten signature in dark ink, appearing to read 'B. Bell'.

Bryan A. Bell

Distribution: 3 copies data, Invoice: Addressee
1 copy data, 1 Set of Photographs, 1 Core Viewer CD: Jeff Anderson at Geomega Inc.

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Disposal Co.
Well: 17N-1
Field: Cymric Area
County,St: Kern County, CA

File No.: 102299
API No.:
Date: 3/4/03
Core Type: Conventional Cores

DEPTH	Horz. Ka(md)	Description
152.8	3073.90	Sd ltan vf-gran slsly mica no stn no flor
180.1	15.31	Slt tan slsdy cly no stn no flor
210.0	5073.51	Sd ltan vf-mgr slsly mica no stn no flor
239.9	29.59	Slt gy-ltan vsdy slcly no stn no flor

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
Well: 17N-1
Field: N/A

File No: 102299

Sample ID: Conv. Cores

SIEVE ANALYSIS

Screen Weights

Opening (Inches) Tyler Mesh Size	0.1850 4	0.1310 6	0.0930 8	0.0650 12	0.0460 16	0.0328 20	0.0232 28	0.0164 35	0.0116 48	0.0082 65	0.0058 100	0.0041 150	0.0029 200	0.0021 270	pan	Total Weight
Well/Depth																
152.8	0.000	0.093	0.226	0.430	0.690	0.255	0.363	0.406	0.572	1.363	1.741	1.770	0.913	0.744	0.955	10.521
180.1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.143	0.554	0.798	1.222	4.750	7.467
210.0	0.000	0.000	0.000	0.000	0.000	0.024	0.201	0.881	2.032	2.267	1.185	0.913	0.515	0.480	0.890	9.388
239.9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.199	0.715	1.226	1.852	1.212	1.346	3.210	9.760

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
Well: 17N-1
Field: N/A

File No: 102299

Sample ID: Conv. Cores

SIEVE ANALYSIS

Percent Weight

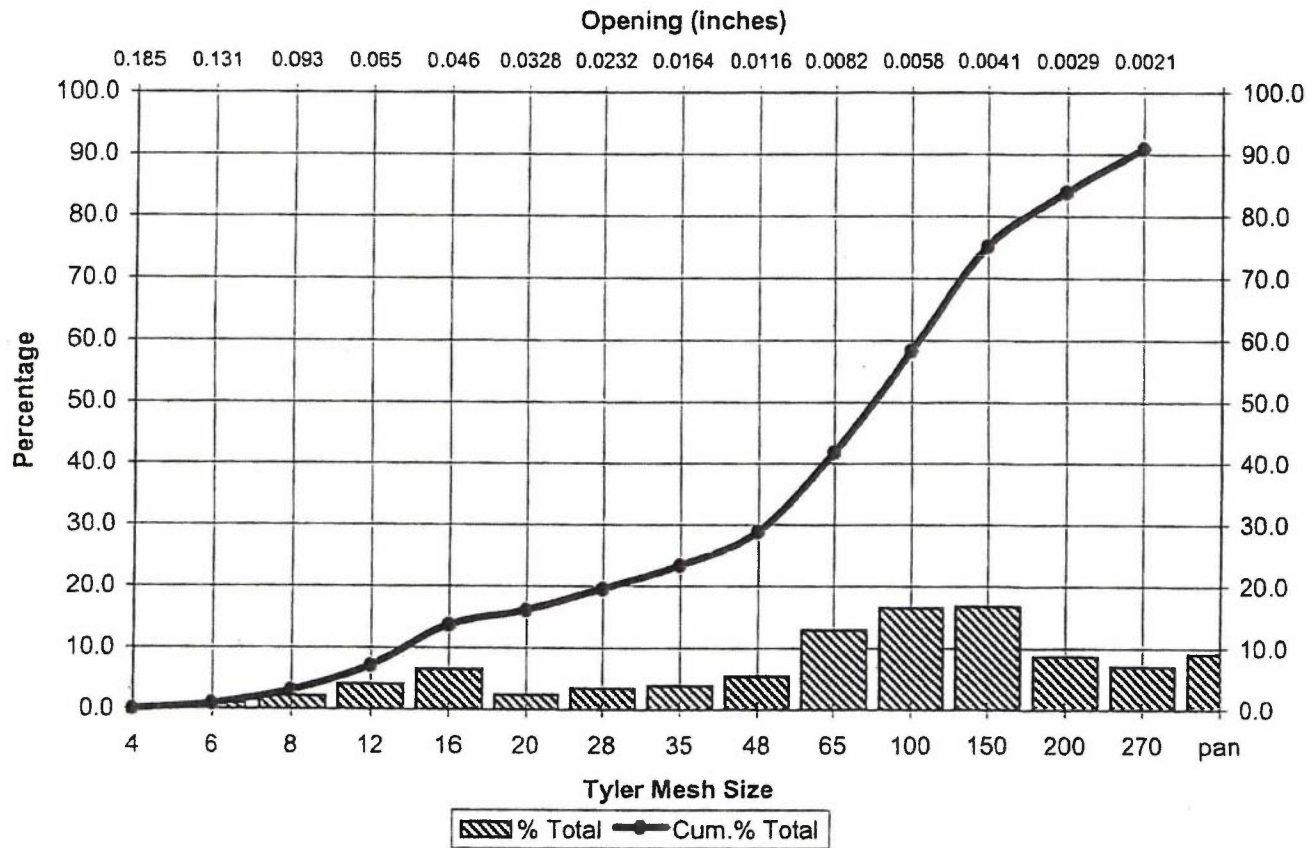
Opening (Inches)	0.1850	0.1310	0.0930	0.0650	0.0460	0.0328	0.0232	0.0164	0.0116	0.0082	0.0058	0.0041	0.0029	0.0021		Total
Tyler Mesh Size	4	6	8	12	16	20	28	35	48	65	100	150	200	270	pan	Weight
Well/Depth																
152.8	0.0	0.9	2.1	4.1	6.6	2.4	3.5	3.9	5.4	13.0	16.5	16.8	8.7	7.1	9.1	10.521
180.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	7.4	10.7	16.4	63.6	7.467
210.0	0.0	0.0	0.0	0.0	0.0	0.3	2.1	9.4	21.6	24.1	12.6	9.7	5.5	5.1	9.5	9.388
239.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	7.3	12.6	19.0	12.4	13.8	32.9	9.760

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
 IL: 17N-1
 Field: N/A

File No: 102299
 Sample ID: Conv. Cores
 Depth: 152.8

SIEVE ANALYSIS



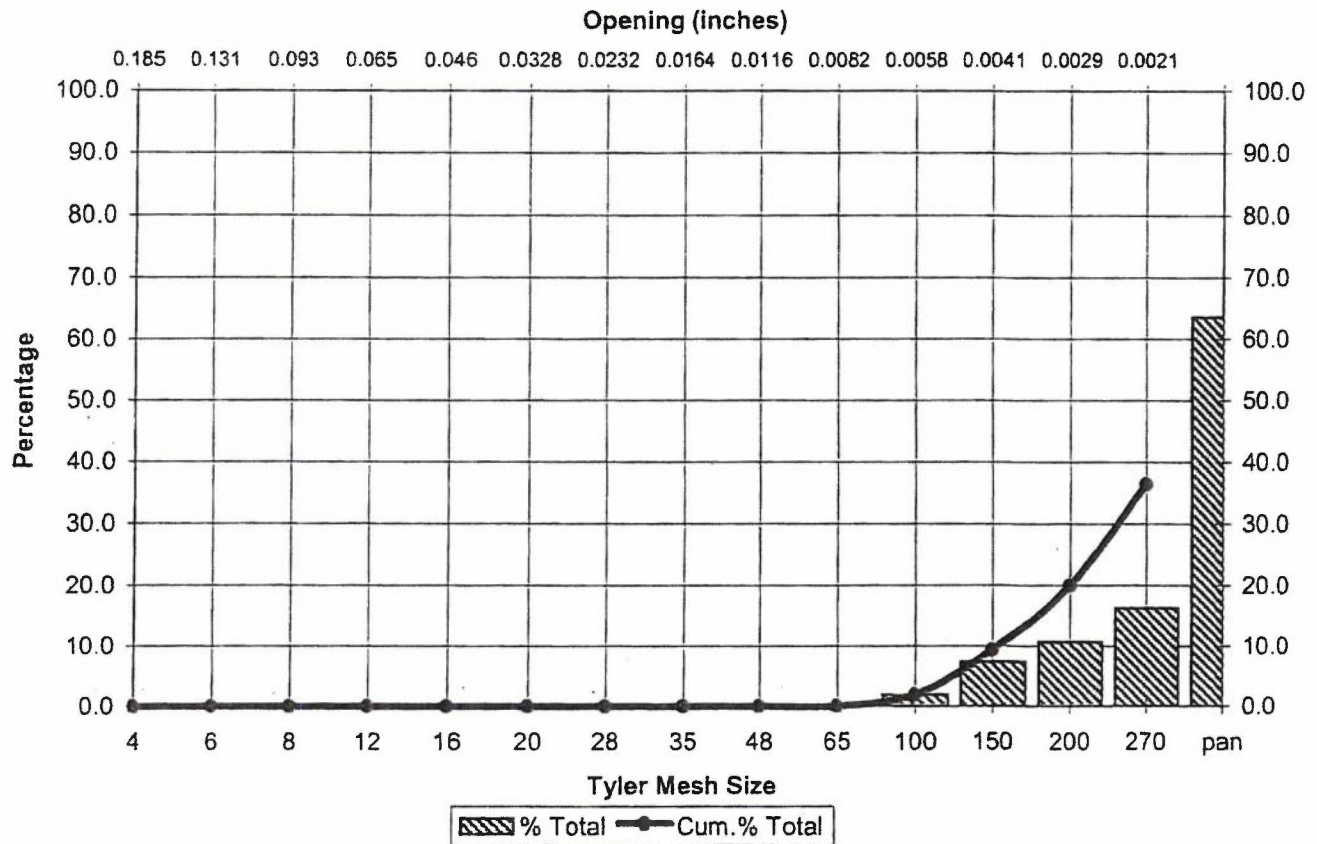
Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	0.00	0.0	0.0	10	0.0567
Gran.	6	0.131	0.09	0.9	0.9	20	0.0224
	8	0.093	0.23	2.1	3.0	30	0.0113
V.Coarse	12	0.065	0.43	4.1	7.1	40	0.0087
	16	0.046	0.69	6.6	13.7	50	0.0070
Coarse	20	0.0328	0.25	2.4	16.1	60	0.0056
	28	0.0232	0.36	3.5	19.6	70	0.0046
Medium	35	0.0164	0.41	3.9	23.4	80	0.0034
	48	0.0116	0.57	5.4	28.8	90	0.0022
Fine	65	0.0082	1.36	13.0	41.8		
	100	0.0058	1.74	16.5	58.3		
V. Fine	150	0.0041	1.77	16.8	75.2		
	200	0.0029	0.91	8.7	83.9		
Silt	270	0.0021	0.74	7.1	90.9		
	pan		0.96	9.1			
Totals			10.52	100.0			

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
 Job: 17N-1
 Field: N/A

File No: 102299
 Sample ID: Conv: Cores
 Depth: 180.1

SIEVE ANALYSIS



Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	0.00	0.0	0.0	10	0.0040
Gran.	6	0.131	0.00	0.0	0.0	20	0.0029
	8	0.093	0.00	0.0	0.0	30	0.0024
V. Coarse	12	0.065	0.00	0.0	0.0	40	**
	16	0.046	0.00	0.0	0.0	50	**
Coarse	20	0.0328	0.00	0.0	0.0	60	**
	28	0.0232	0.00	0.0	0.0	70	**
Medium	35	0.0164	0.00	0.0	0.0	80	**
	48	0.0116	0.00	0.0	0.0	90	**
Fine	65	0.0082	0.00	0.0	0.0		
	100	0.0058	0.14	1.9	1.9		
V. Fine	150	0.0041	0.55	7.4	9.3		
	200	0.0029	0.80	10.7	20.0		
Silt	270	0.0021	1.22	16.4	36.4		
	pan		4.75	63.6			
Totals			7.47	100.0			

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.

IL: 17N-1

Field: N/A

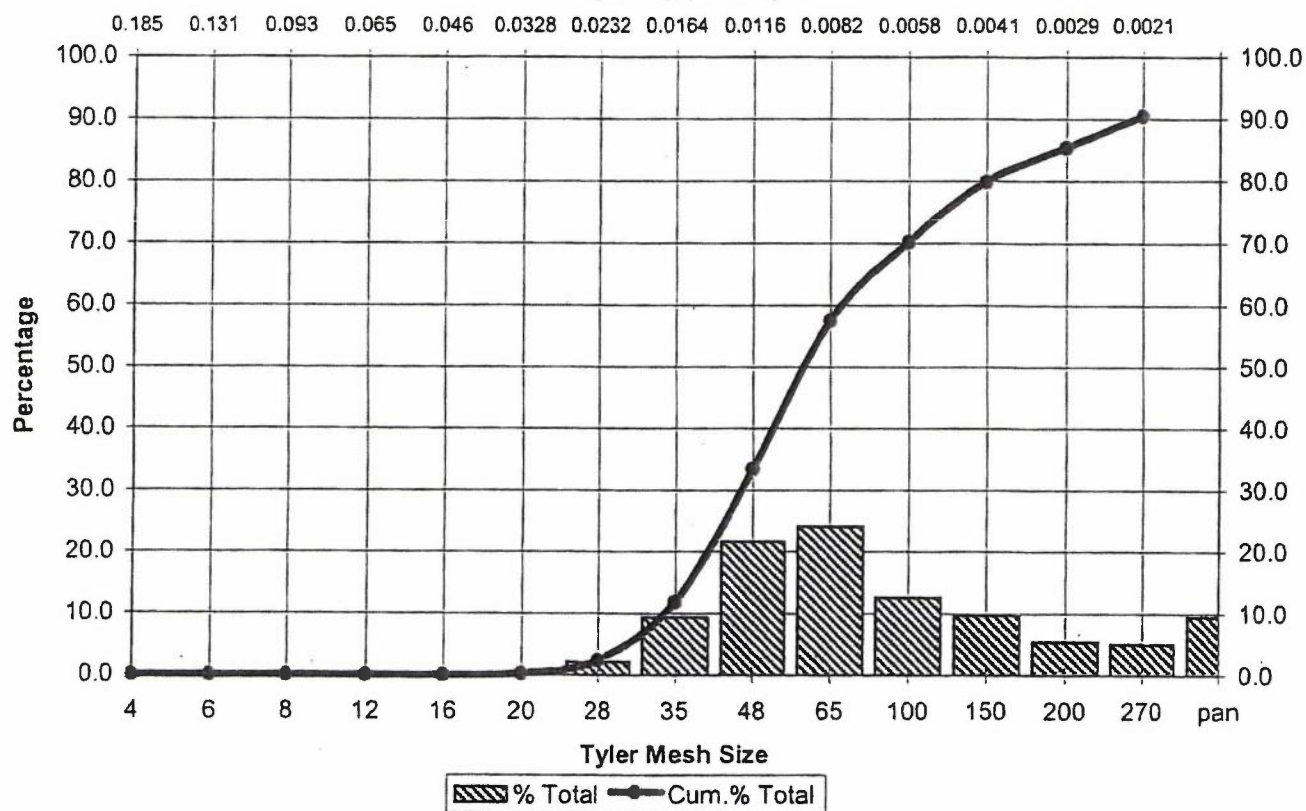
File No: 102299

Sample ID: Conv. Cores

Depth: 210

SIEVE ANALYSIS

Opening (inches)



Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	0.00	0.0	0.0	10	0.0177
Gran.	6	0.131	0.00	0.0	0.0	20	0.0146
	8	0.093	0.00	0.0	0.0	30	0.0124
V. Coarse	12	0.065	0.00	0.0	0.0	40	0.0107
	16	0.046	0.00	0.0	0.0	50	0.0093
Coarse	20	0.0328	0.02	0.3	0.3	60	0.0077
	28	0.0232	0.20	2.1	2.4	70	0.0058
Medium	35	0.0164	0.88	9.4	11.8	80	0.0041
	48	0.0116	2.03	21.6	33.4	90	0.0022
Fine	65	0.0082	2.27	24.1	57.6		
	100	0.0058	1.19	12.6	70.2		
V. Fine	150	0.0041	0.91	9.7	79.9		
	200	0.0029	0.52	5.5	85.4		
Silt	270	0.0021	0.48	5.1	90.5		
	pan		0.89	9.5			

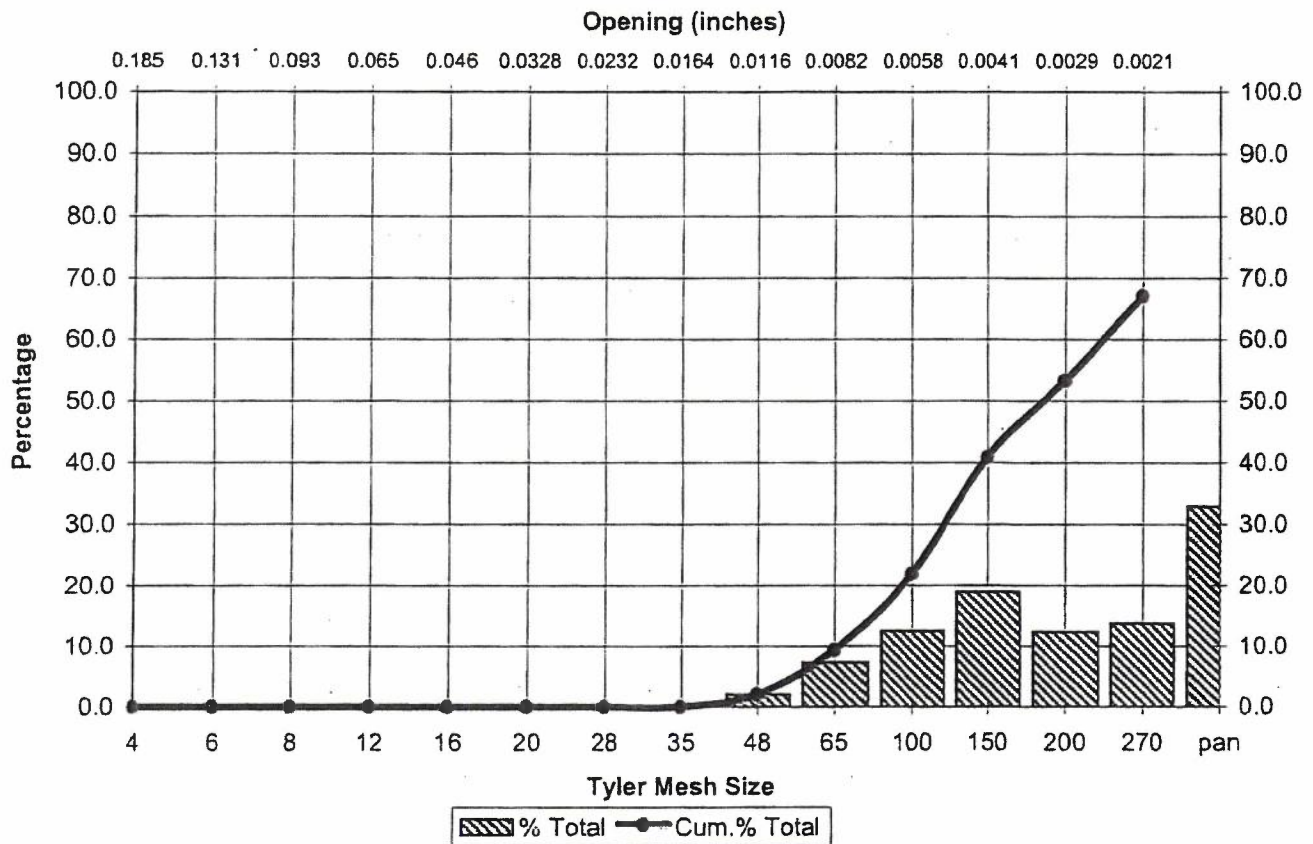
Totals 9.39 100.0

GOODE CORE ANALYSIS SERVICE

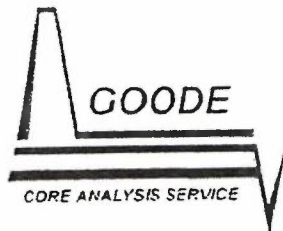
Company: Valley Waste Corp.
 IL: 17N-1
 Field: N/A

File No: 102299
 Sample ID: Conv. Cores
 Depth: 239.9

SIEVE ANALYSIS



Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	0.00	0.0	0.0	10	0.0081
Gran.	6	0.131	0.00	0.0	0.0	20	0.0062
	8	0.093	0.00	0.0	0.0	30	0.0051
V. Coarse	12	0.065	0.00	0.0	0.0	40	0.0042
	16	0.046	0.00	0.0	0.0	50	0.0032
Coarse	20	0.0328	0.00	0.0	0.0	60	0.0025
	28	0.0232	0.00	0.0	0.0	70	**
Medium	35	0.0164	0.00	0.0	0.0	80	**
	48	0.0116	0.20	2.0	2.0	90	**
Fine	65	0.0082	0.72	7.3	9.4		
	100	0.0058	1.23	12.6	21.9		
V. Fine	150	0.0041	1.85	19.0	40.9		
	200	0.0029	1.21	12.4	53.3		
Silt	270	0.0021	1.35	13.8	67.1		
	pan		3.21	32.9			
Totals			9.76	100.0			



1400 Easton Drive, Suite 111 • Bakersfield, CA 93309 • (661) 322-5540 • Fax (661) 322-5576

March 6, 2003

Mr. Larry Bright
Valley Waste Disposal Co.
1400 Easton Dr. Suite 139B
Bakersfield, CA 93309

Subject: Core Analysis Data
Well: 21D-1
Cymric Area
Kern, CA
File No.: 102278

Dear Mr Bright

Conventional cores recovered from the subject well were packaged and transported to our laboratory by Chevron USA personnel. The results of these measurements are presented in the accompanying report.

The cores were delivered to Goode Core Analysis and refrigerated in boxes with about 10 feet per box. The cores were photographed for presentation with our Core Viewer. Photographs under white light are presented with one box per page.

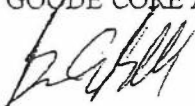
Selected depths were chosen for petrophysical testing. Sample locations selected were arbor cut or drilled using liquid nitrogen as the bit coolant. Samples were encased in sleeves with 100 mesh end screens to hold the sample intact. The sleeves were seated to the sample by applying a pressure 400 psig. Weight difference determined saturations. Prior to measurement of porosity and permeability to air, the samples were dried at 235 degrees Fahrenheit. Porosity was determined by Boyle's Law method using helium as the gaseous medium. Pore volume and permeability measurements were made with a confining pressure of 250 psig. The analysis procedures are noted on the data pages.

Grain size measurements were determined on each sample. The dried sample was reduced to grain size and subsequently passed through a set of Tyler mesh screens. Percent weight and cumulative weight percent are presented in both tabular and graphical form.

We are pleased to have performed this service and trust we will be called upon again in the future.

Very Truly Yours,

GOODE CORE ANALYSIS SERVICE


Bryan A. Bell

Distribution: 3 copies data, Invoice: Addressee
1 copy data, 1 Set of Photographs, 1 Core Viewer CD: Jeff Anderson at Geomega Inc.

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Disposal Co.

Well: 21D-1

Field: Cymric Area

County, St: Kern County, CA

File No.: 102278

API No.:

Date: 3/4/03

Core Type: Conventional Cores

DEPTH	Horz. Ka(md)	Description
224.9	2622.62	Sd ltan vf-cgr slsly mica no stn no flor
269.9	7.09	Slt ltan vsdy slcly no stn no flor
280.0	1864.92	Sd ltan vf-gran slsly no stn no flor

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
Well: 21D-1
Field: N/A

File No: 102278

Sample ID: Conv. Cores

SIEVE ANALYSIS

Screen Weights

Opening (Inches)	0.1850	0.1310	0.0930	0.0650	0.0460	0.0328	0.0232	0.0164	0.0116	0.0082	0.0058	0.0041	0.0029	0.0021		Total
Tyler Mesh Size	4	6	8	12	16	20	28	35	48	65	100	150	200	270	pan	Weight
Well/Depth																
224.9	0.000	0.000	0.000	0.022	0.245	0.568	1.285	2.120	2.134	2.008	1.290	1.359	0.891	0.776	1.075	13.773
269.9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.109	0.617	1.251	2.013	1.297	1.638	4.165	11.090
280.0	0.142	0.837	1.606	2.256	3.261	2.773	2.584	2.603	2.527	2.594	1.566	1.273	0.689	0.704	1.070	26.485

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
Well: 21D-1
Field: N/A

File No: 102278

Sample ID: Conv. Cores

SIEVE ANALYSIS

Percent Weight

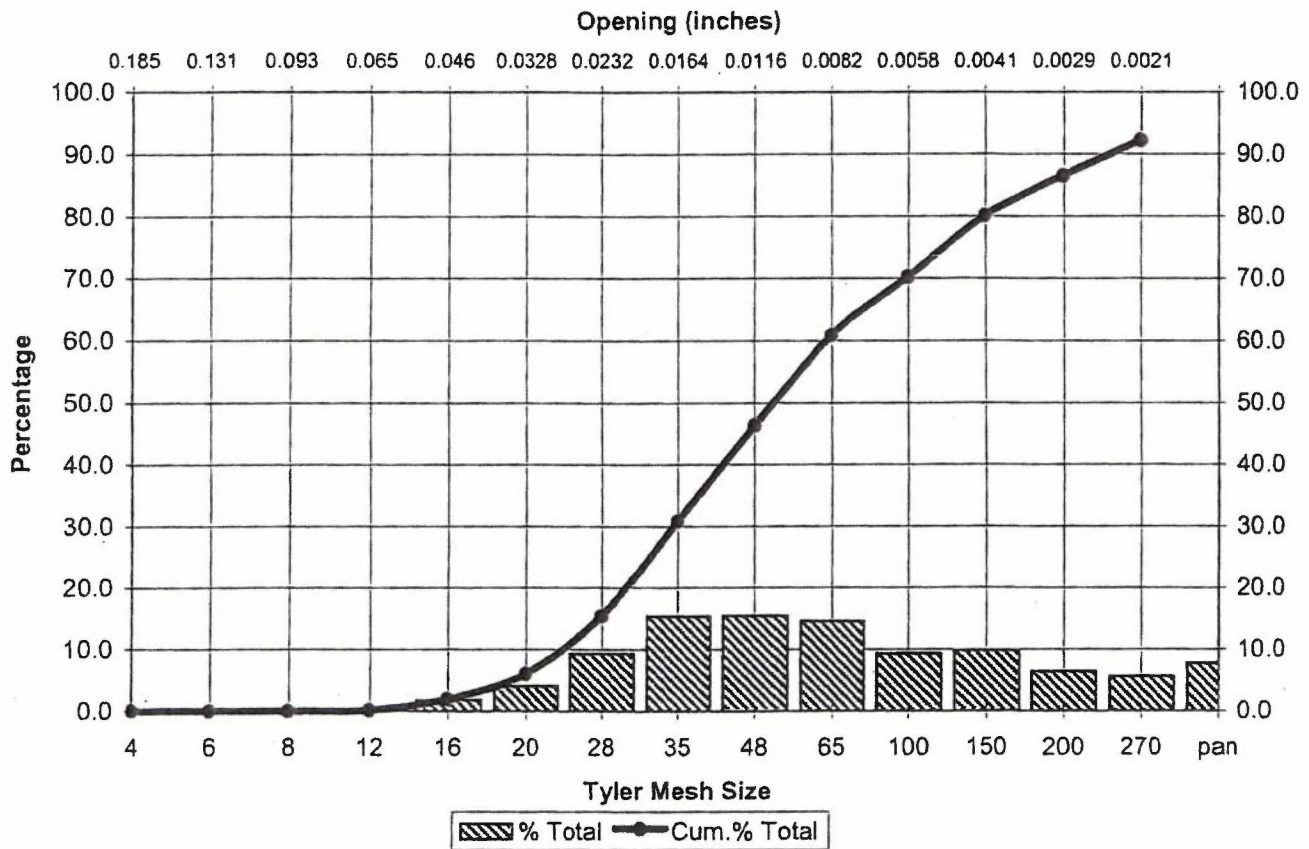
Opening (Inches)	0.1850	0.1310	0.0930	0.0650	0.0460	0.0328	0.0232	0.0164	0.0116	0.0082	0.0058	0.0041	0.0029	0.0021		Total
S Tyler Mesh Size	4	6	8	12	16	20	28	35	48	65	100	150	200	270	pan	Weight
Well/Depth																
224.9	0.0	0.0	0.0	0.2	1.8	4.1	9.3	15.4	15.5	14.6	9.4	9.9	6.5	5.6	7.8	13.773
269.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.6	11.3	18.2	11.7	14.8	37.6	11.090
280.0	0.5	3.2	6.1	8.5	12.3	10.5	9.8	9.8	9.5	9.8	5.9	4.8	2.6	2.7	4.0	26.485

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
 Cell: 21D-1
 Field: N/A

File No: 102278
 Sample ID: Conv. Cores
 Depth: 224.9

SIEVE ANALYSIS



Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	0.00	0.0	0.0	10	0.0287
Gran.	6	0.131	0.00	0.0	0.0	20	0.0212
	8	0.093	0.00	0.0	0.0	30	0.0167
V.Coarse	12	0.065	0.02	0.2	0.2	40	0.0135
	16	0.046	0.25	1.8	1.9	50	0.0107
Coarse	20	0.0328	0.57	4.1	6.1	60	0.0084
	28	0.0232	1.29	9.3	15.4	70	0.0059
Medium	35	0.0164	2.12	15.4	30.8	80	0.0041
	48	0.0116	2.13	15.5	46.3	90	0.0024
Fine	65	0.0082	2.01	14.6	60.9		
	100	0.0058	1.29	9.4	70.2		
V. Fine	150	0.0041	1.36	9.9	80.1		
	200	0.0029	0.89	6.5	86.6		
Silt	270	0.0021	0.78	5.6	92.2		
	pan		1.08	7.8			
Totals			13.77	100.0			

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.

Well: 21D-1

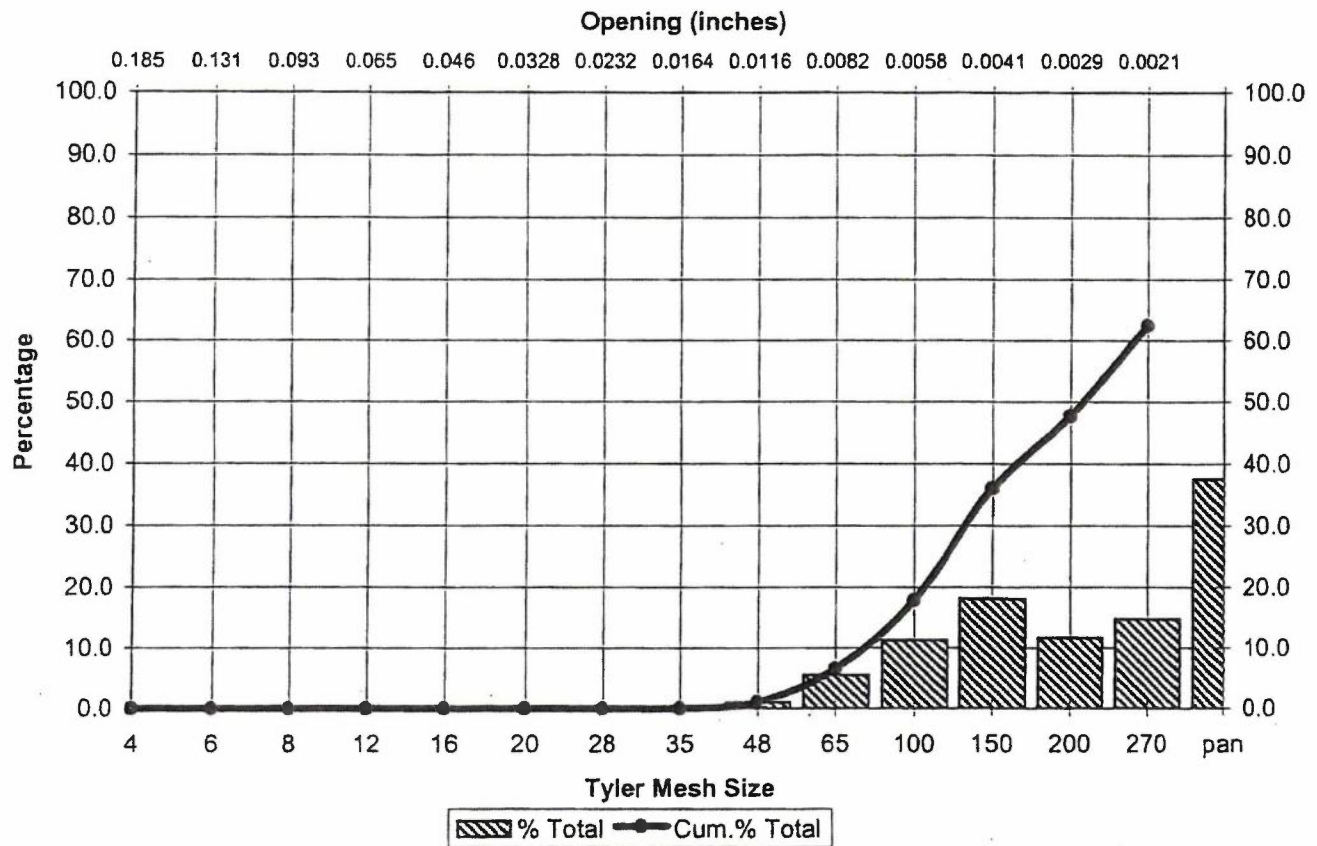
Field: N/A

File No: 102278

Sample ID: Conv. Cores

Depth: 269.9

SIEVE ANALYSIS



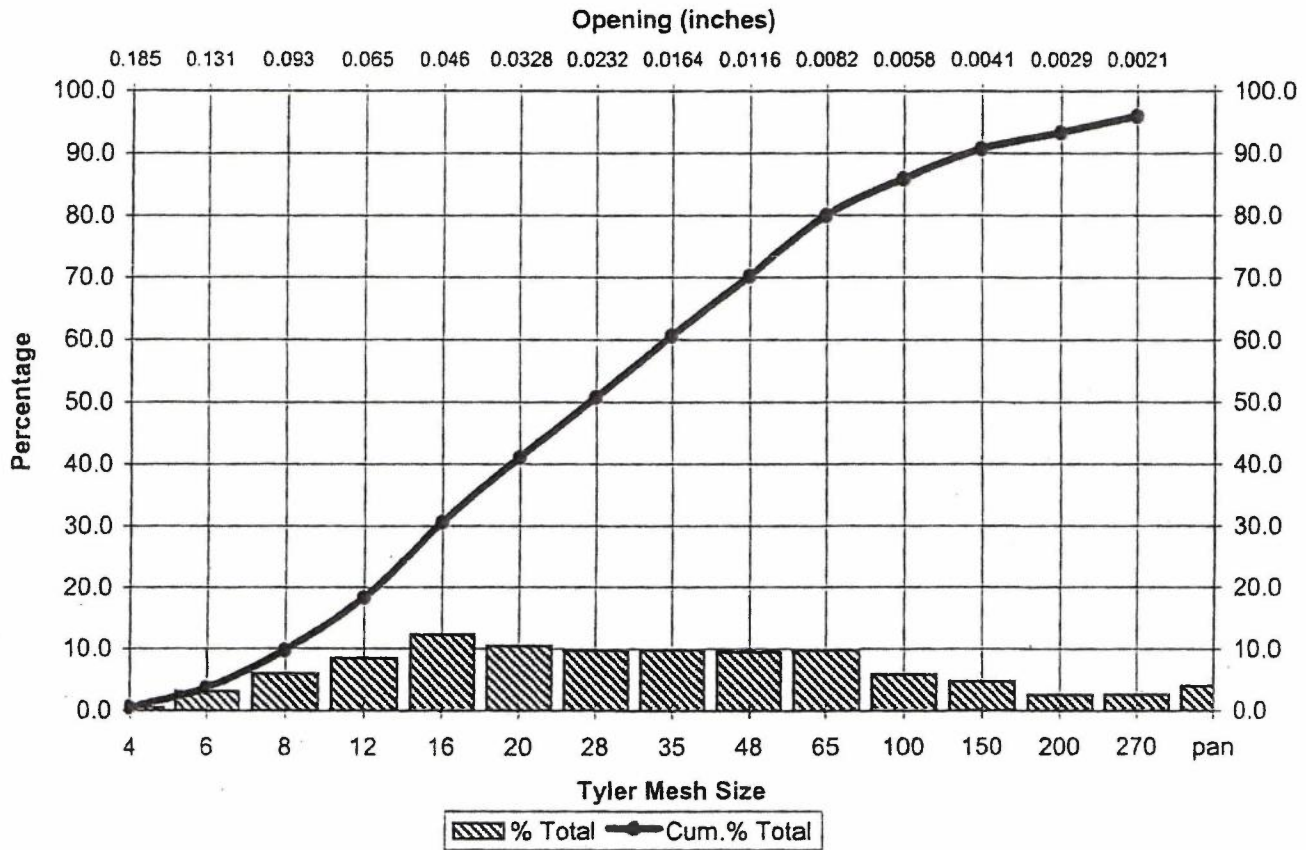
Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	0.00	0.0	0.0	10	0.0075
Gran.	6	0.131	0.00	0.0	0.0	20	0.0056
	8	0.093	0.00	0.0	0.0	30	0.0047
V. Coarse	12	0.065	0.00	0.0	0.0	40	0.0037
	16	0.046	0.00	0.0	0.0	50	0.0028
	20	0.0328	0.00	0.0	0.0	60	0.0022
Coarse	28	0.0232	0.00	0.0	0.0	70	**
	35	0.0164	0.00	0.0	0.0	80	**
Medium	48	0.0116	0.11	1.0	1.0	90	**
	65	0.0082	0.62	5.6	6.5		
Fine	100	0.0058	1.25	11.3	17.8		
	150	0.0041	2.01	18.2	36.0		
V. Fine	200	0.0029	1.30	11.7	47.7		
	270	0.0021	1.64	14.8	62.4		
Silt	pan		4.16	37.6			
Totals			11.09	100.0			

GOODE CORE ANALYSIS SERVICE

Company: Valley Waste Corp.
Well: 21D-1
Field: N/A

File No: 102278
Sample ID: Conv. Cores
Depth: 280

SIEVE ANALYSIS

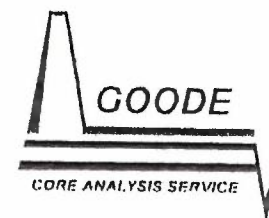


Grain Size	Tyler Mesh	Opening Inches	Sample Weight	Percent Total	Cumulative % Weight	Percent Retained	Opening Inches
Pebble	4	0.185	0.14	0.5	0.5	10	0.0922
Gran.	6	0.131	0.84	3.2	3.7	20	0.0623
	8	0.093	1.61	6.1	9.8	30	0.0469
V.Coarse	12	0.065	2.26	8.5	18.3	40	0.0341
	16	0.046	3.26	12.3	30.6	50	0.0240
Coarse	20	0.0328	2.77	10.5	41.1	60	0.0168
	28	0.0232	2.58	9.8	50.8	70	0.0117
Medium	35	0.0164	2.60	9.8	60.6	80	0.0082
	48	0.0116	2.53	9.5	70.2	90	0.0043
Fine	65	0.0082	2.59	9.8	80.0		
	100	0.0058	1.57	5.9	85.9		
V. Fine	150	0.0041	1.27	4.8	90.7		
	200	0.0029	0.69	2.6	93.3		
Silt	270	0.0021	0.70	2.7	96.0		
	pan		1.07	4.0			

Totals 26.49 100.0

BOX 9 OF 9

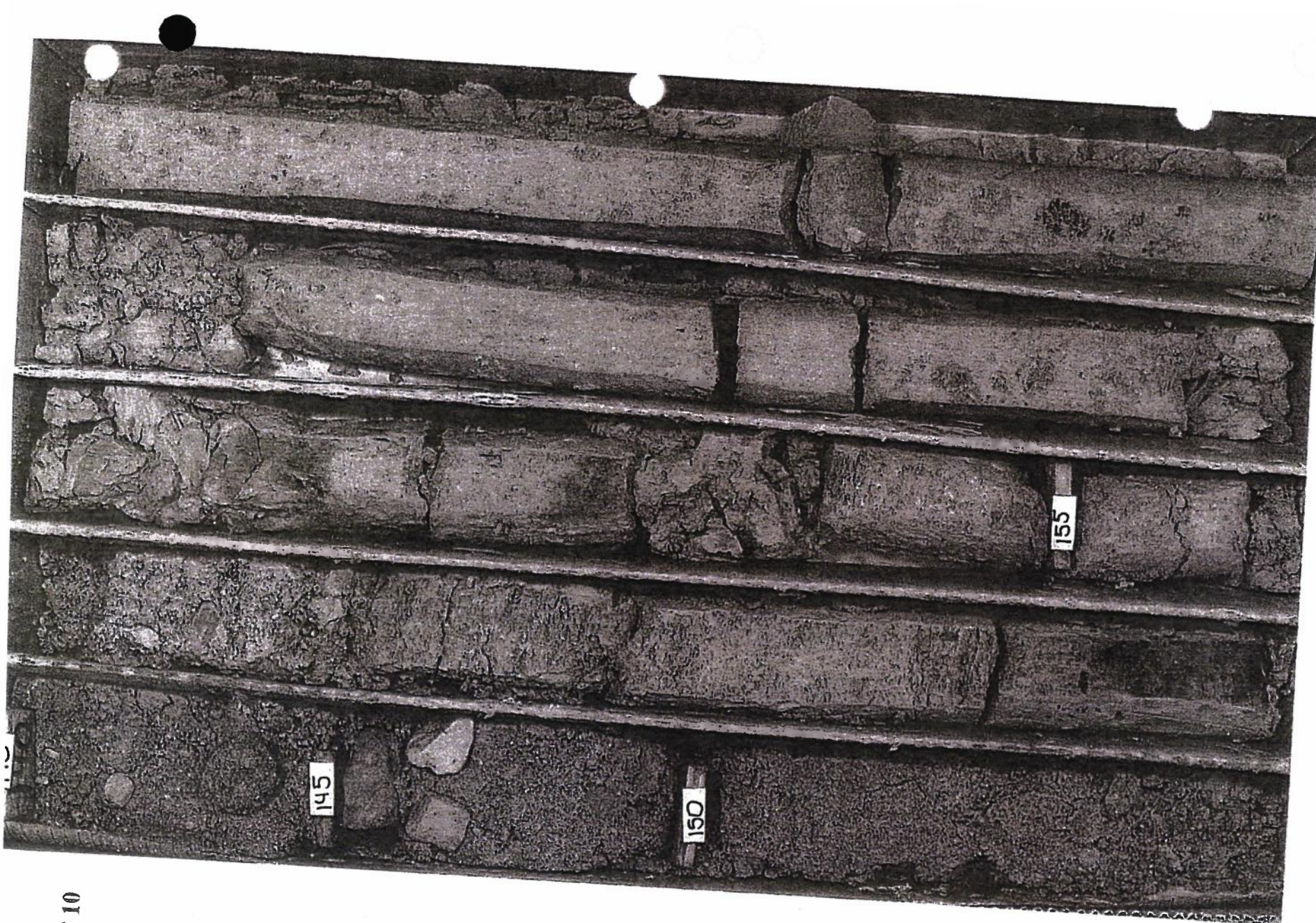
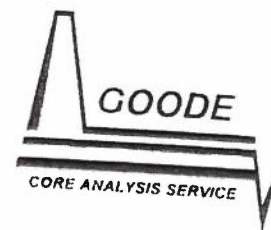
Company: Valley Waste Disposal
Well: 17 N 1



240

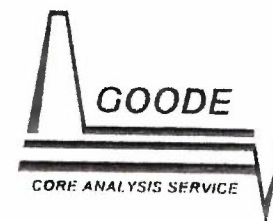
BOX 1 OF 10

Company: Valley Waste Disposal
Well: 19 H 1



BOX 2 OF 9

Company: Valley Waste Disposal
Well: 19 H 1



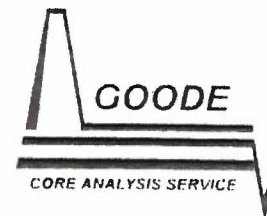
BOX 3 OF 9

Company: Valley Waste Disposal
Well: 19 H 1



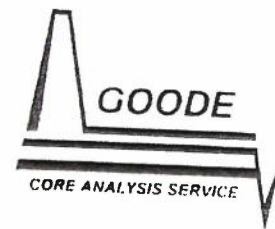
BOX 4 OF 9

Company: Valley Waste Disposal
Well: 19 H1



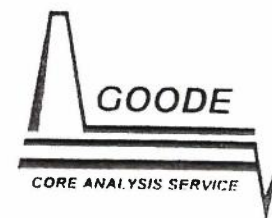
BOX 5 OF 9

Company: Valley Waste Disposal
Well: 19 H 1



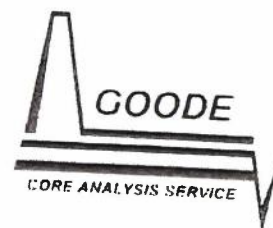
BOX 6 OF 9

Company: Valley Waste Disposal
Well: 19 H 1



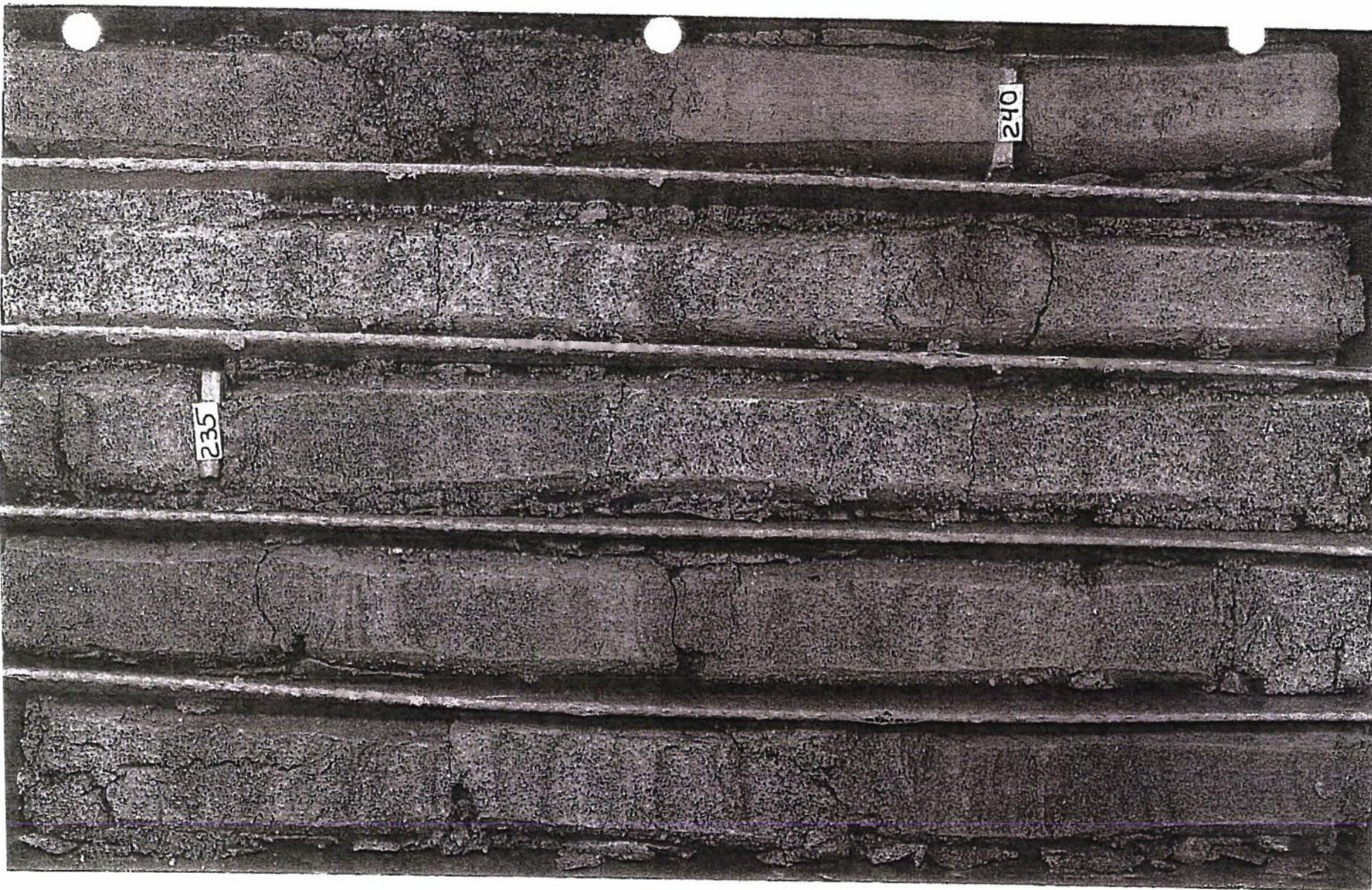
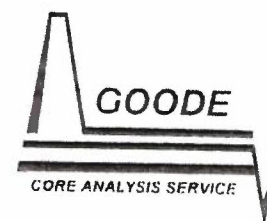
BOX 7 OF 9

Company: Valley Waste Disposal
Well: 19 H 1



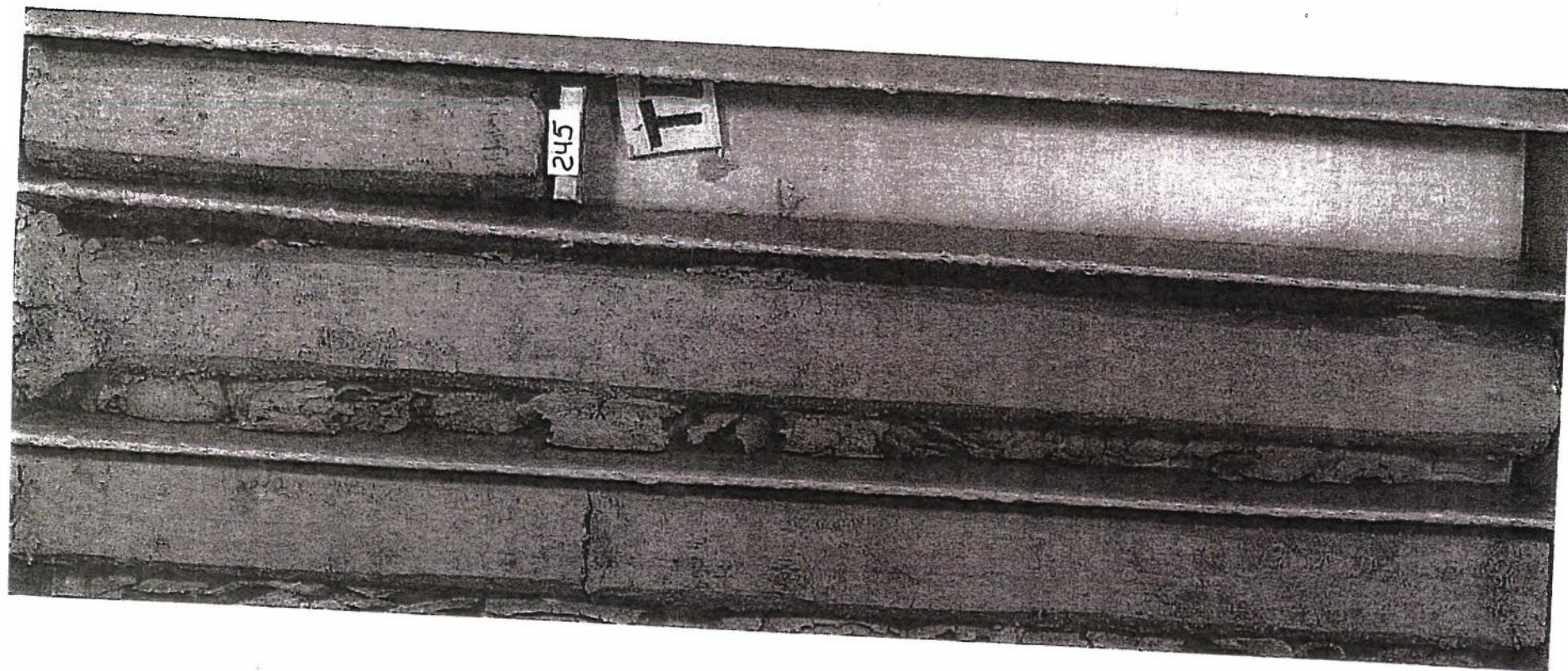
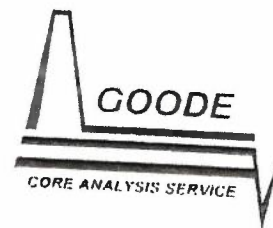
BOX 8 OF 9

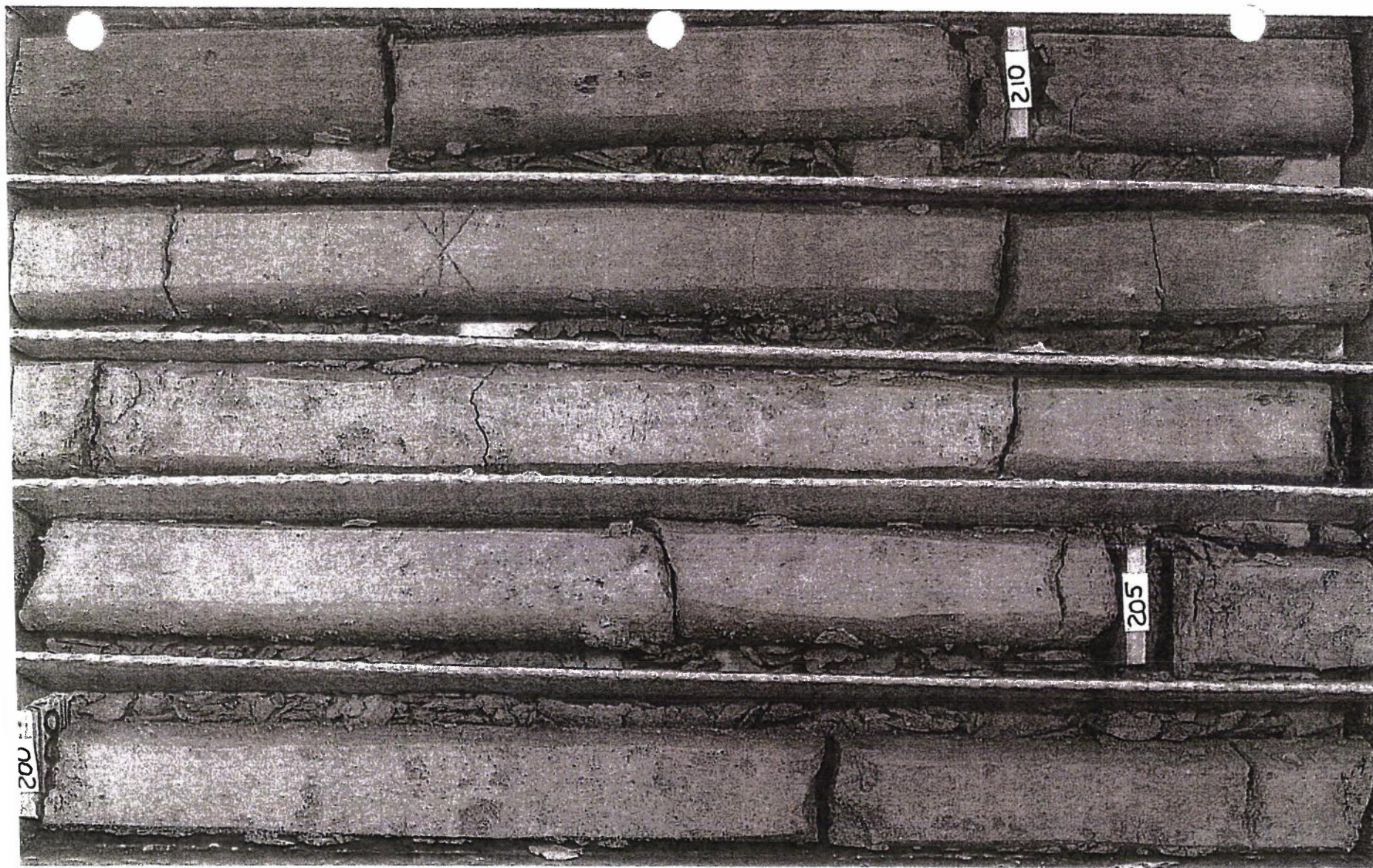
Company: Valley Waste Disposal
Well: 19 H 1



BOX 9 OF 9

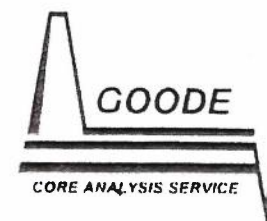
Company: Valley Waste Disposal
Well: 19 H1





BOX 1 OF 10

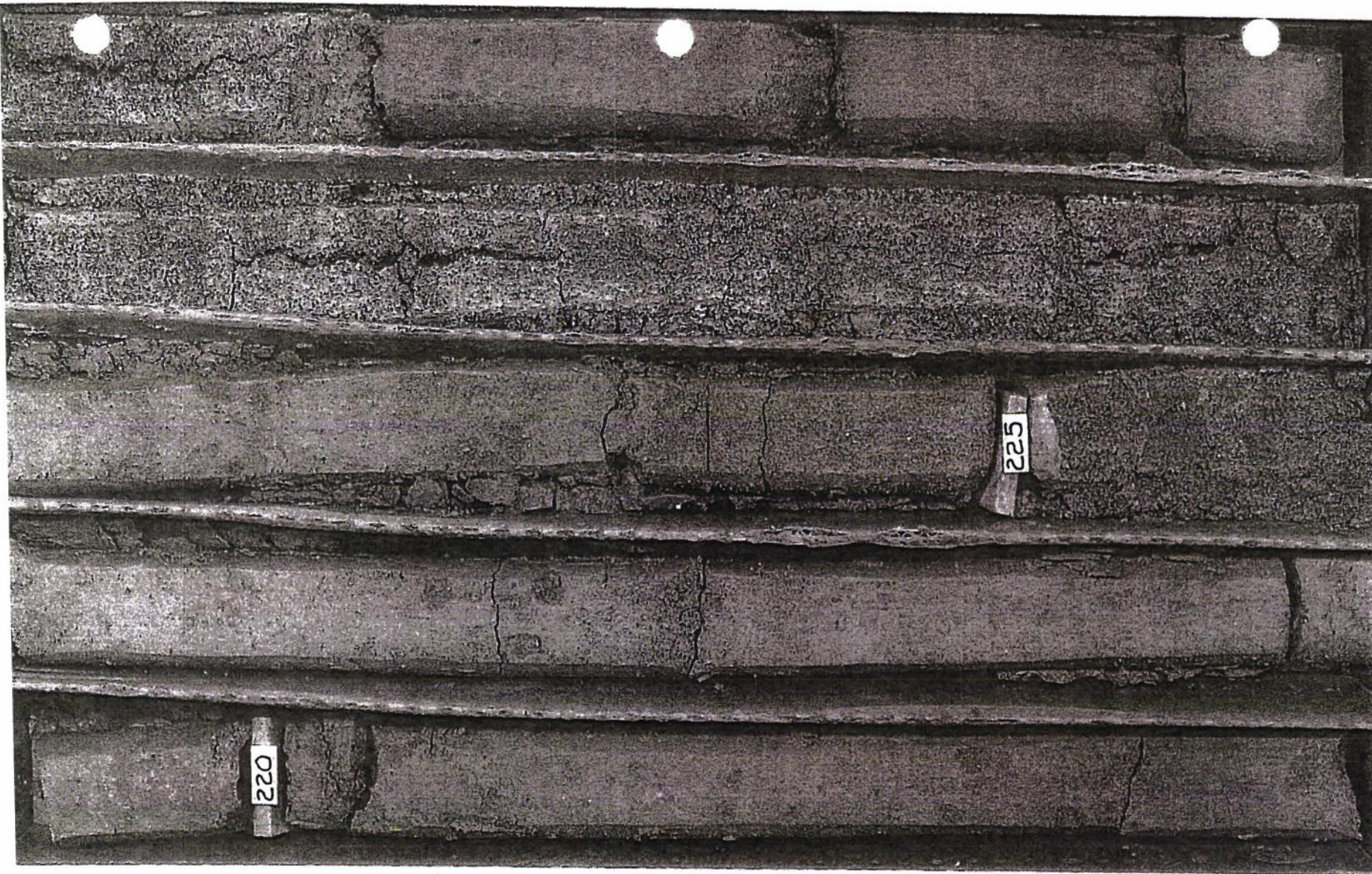
Company: Valley Waste Disposal
Well: 21 D 1



BOX 2 OF 10

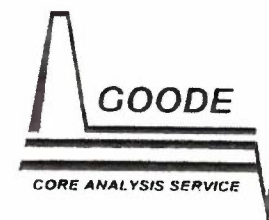
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Well: 21 D 1

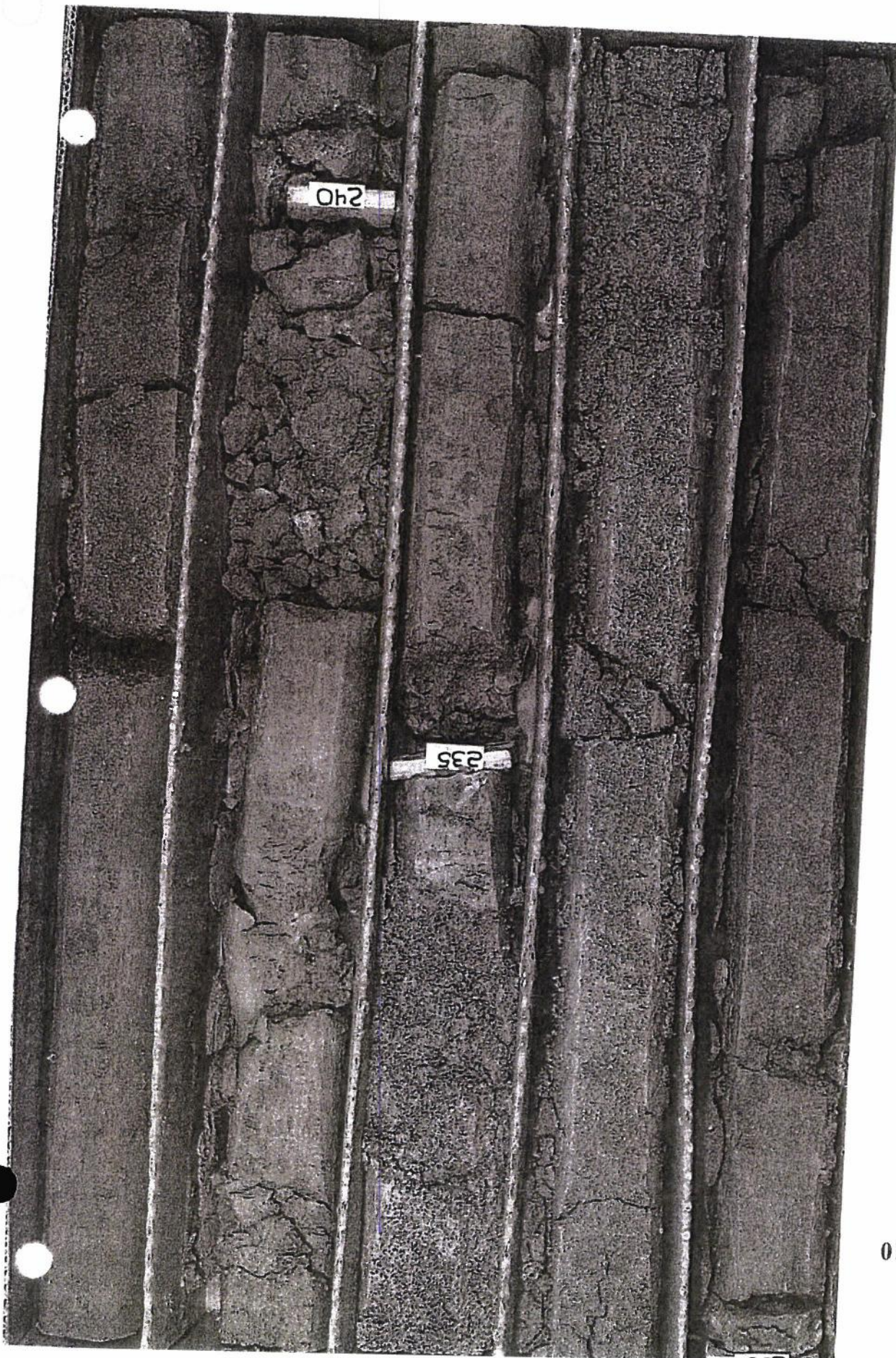




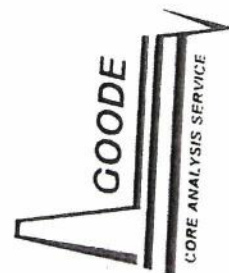
BOX 3 OF 10

Company: Valley Waste Disposal
Well: 21 D 1



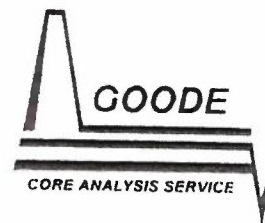


Company: Valley Waste Disposal
Well: 21 D 1



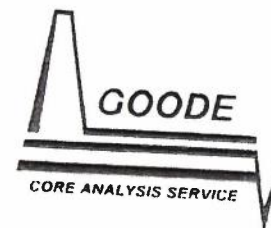
BOX 5 OF 10

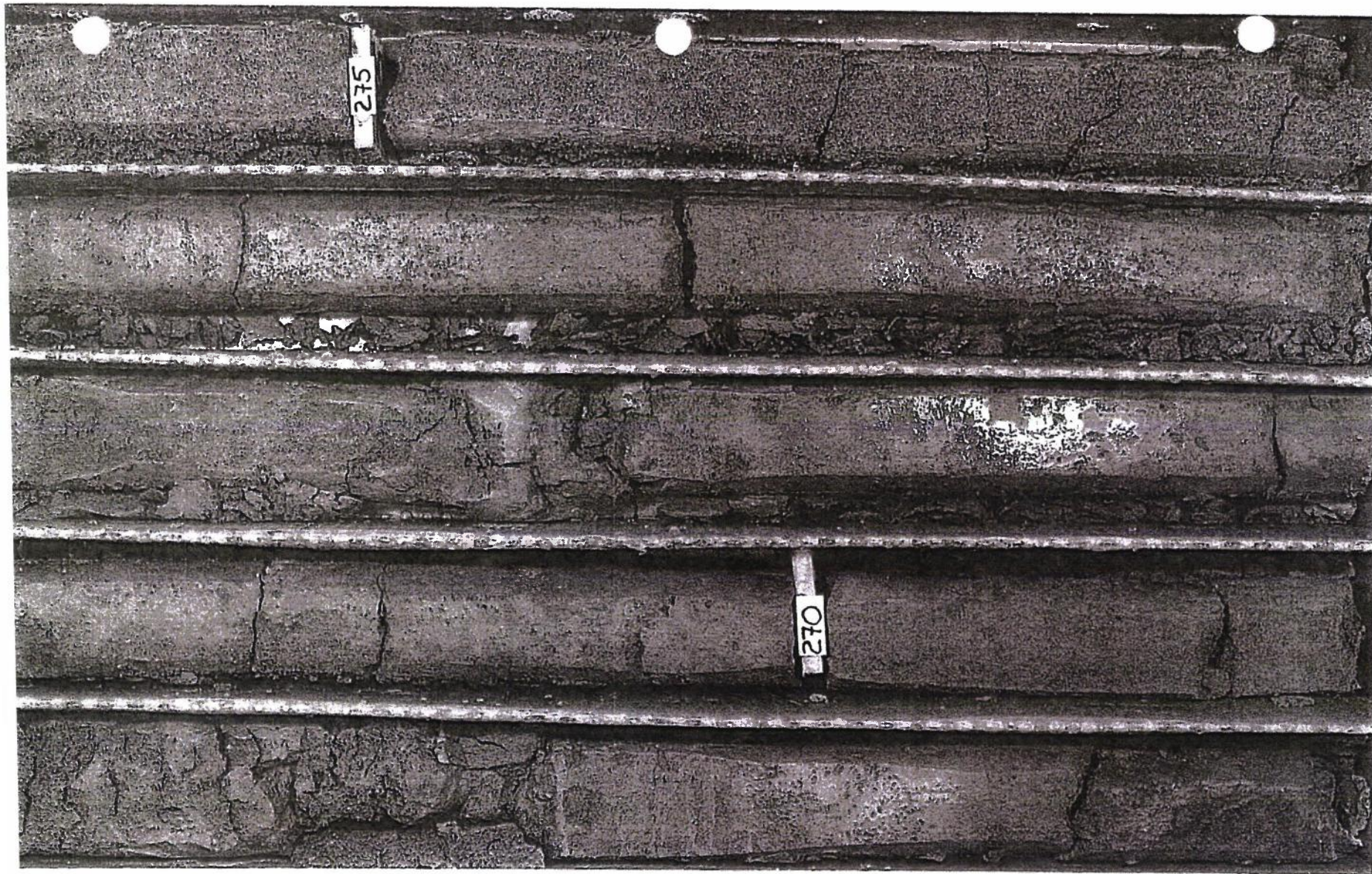
Company: Valley Waste Disposal
Well: 21 D 1



BOX 6 OF 10

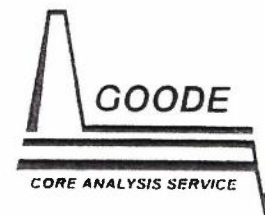
Company: Valley Waste Disposal
Well: 21 D 1





BOX 7 OF 10

Company: Valley Waste Disposal
Well: 21 D 1



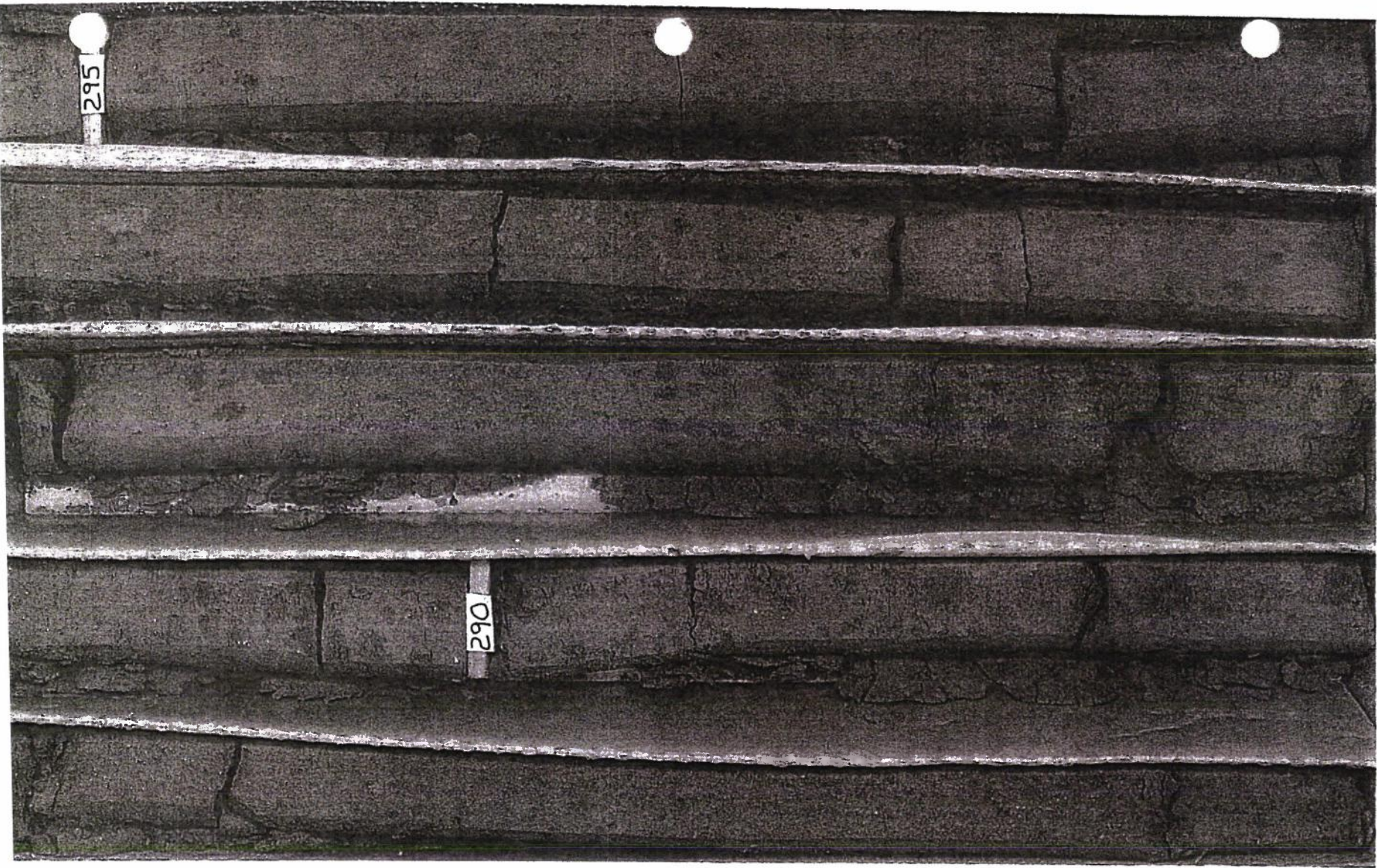
BOX 8 OF 10

Company: Valley Waste Disposal
Well: 21 D 1



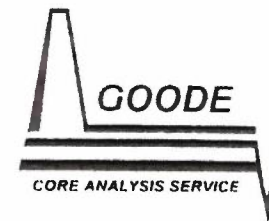
280

285



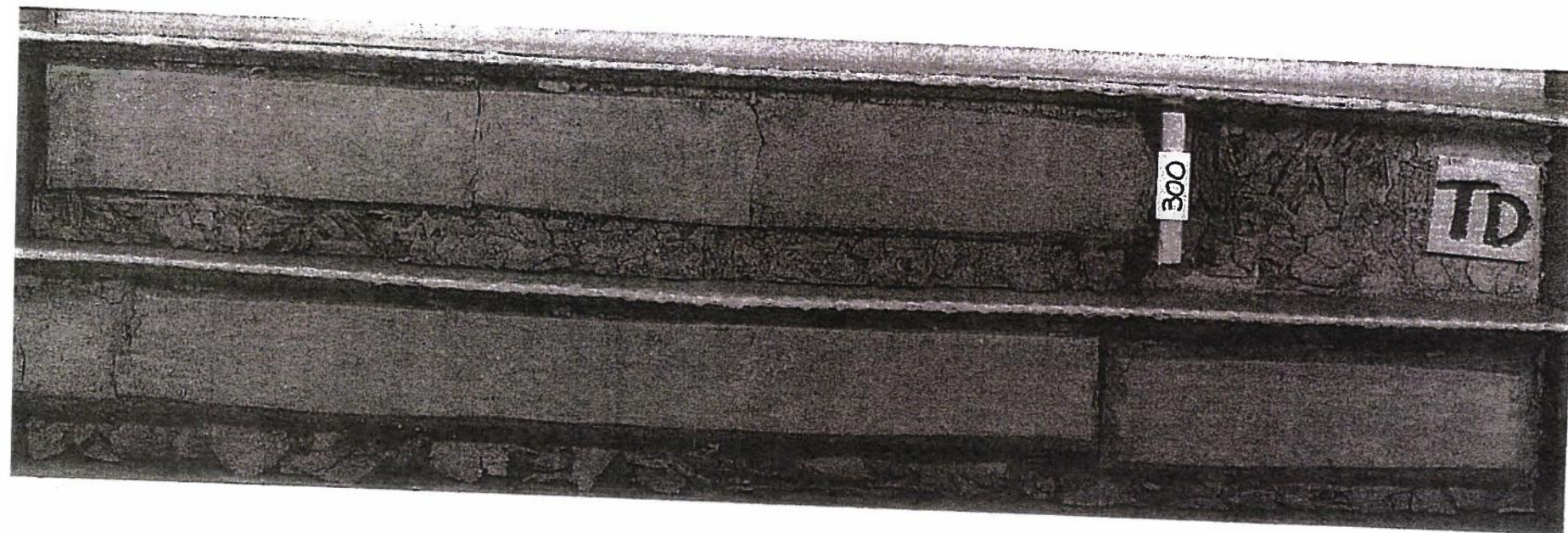
BOX 9 OF 10

Company: Valley Waste Disposal
Well: 21 D 1



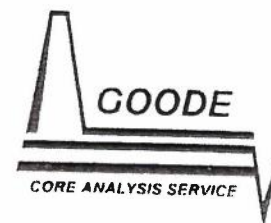
BOX 10 OF 10

Company: Valley Waste Disposal
Well: 21 D 1



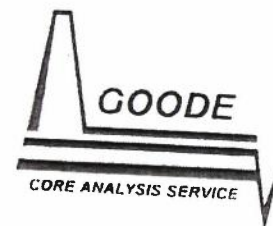
BOX 1 OF 9

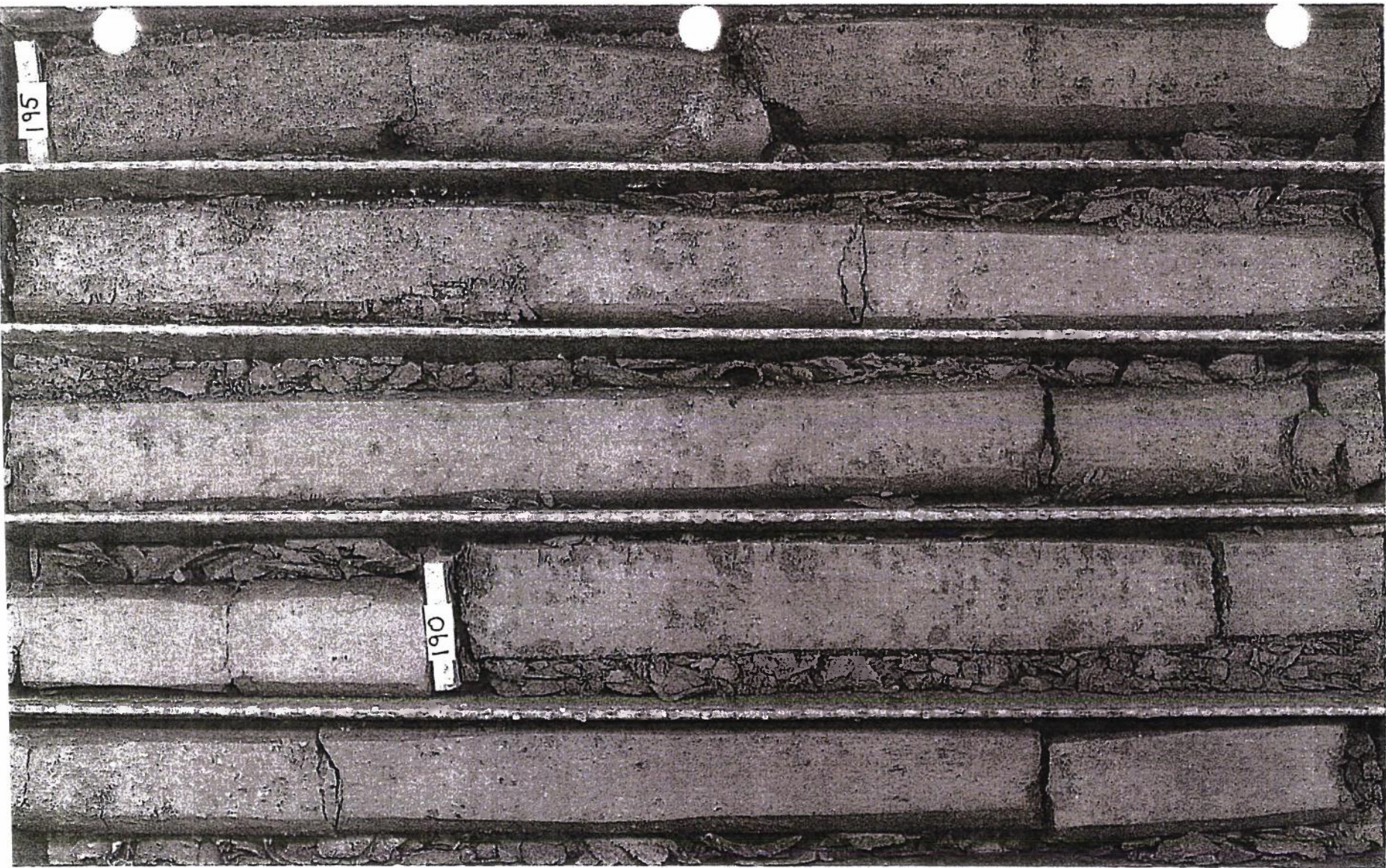
Company: Valley Waste Disposal
Well: 17 N 1



BOX 2 OF 9

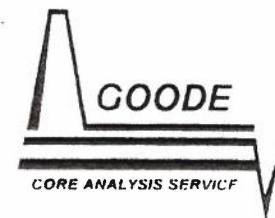
Company: Valley Waste Disposal
Well: 17 N 1





BOX 5 OF 9

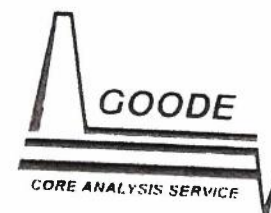
Company: Valley Waste Disposal
Well: 17 N 1





BOX 6 OF 9

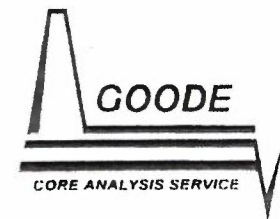
Company: Valley Waste Disposal
Well: 17 N 1





BOX 7 OF 9

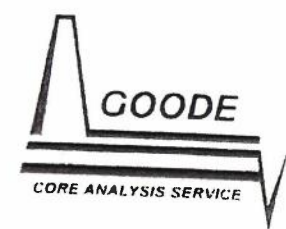
Company: Valley Waste Disposal
Well: 17 N 1





BOX 8 OF 9

Company: Valley Waste Disposal
Well: 17 N 1



Appendix B

Company: VALLEY WASTE DISPOSAL

Well: CYM - 17N1

Field: CYMRIC

County: KERN

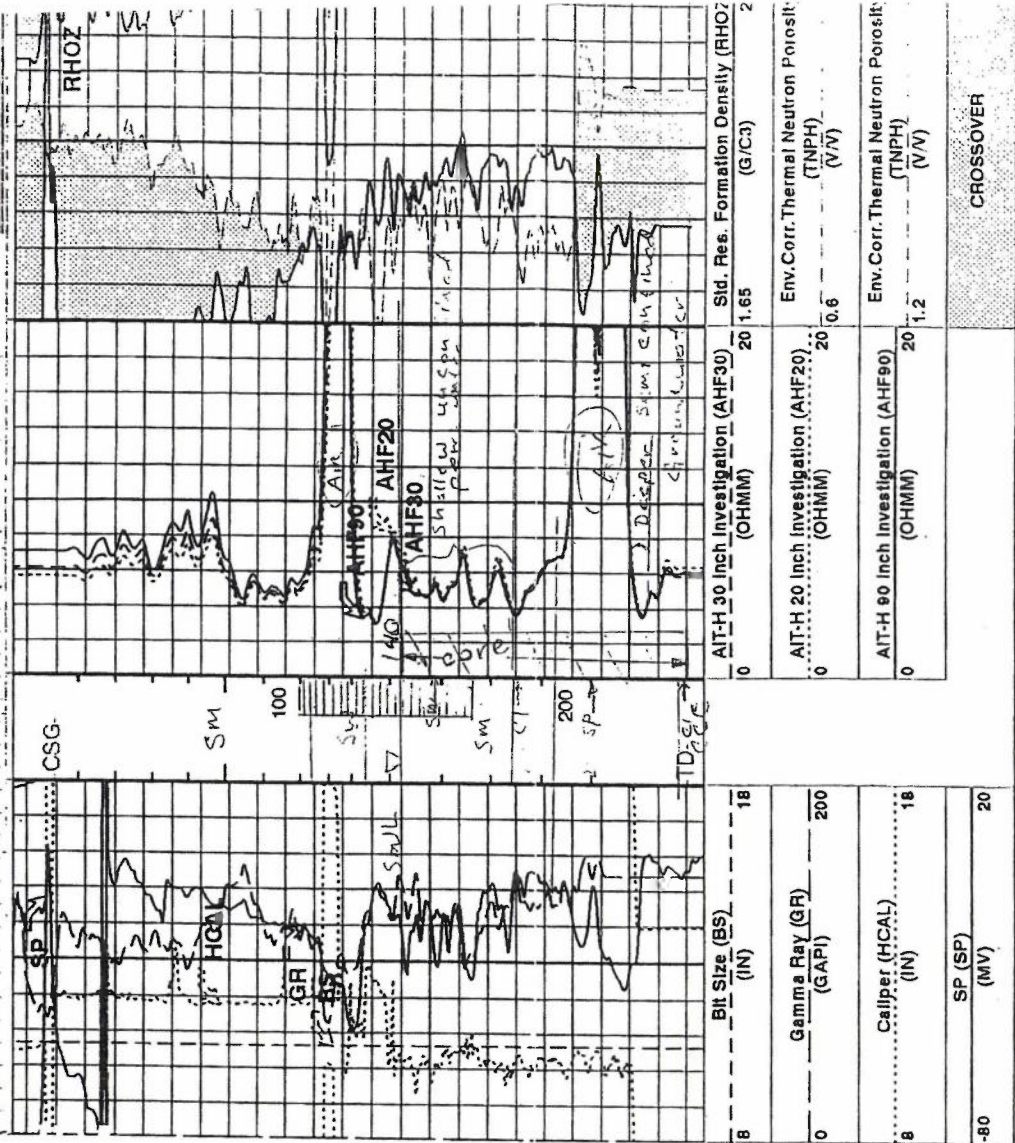
State: CALIFORNIA

PLATFORM EXPRESS
ARRAY INDUCTION / GR / SP
DENSITY / NEUTRON

County: KERN
Field: CYMRIC
Location: CYM - 17N1
Well: VALLEY WASTE DISPOSAL

Permanent Datum: <u>GROUND LEVEL</u>		Elev.: K.B. G.L. D.F.	
Log Measured From: <u>GROUND LEVEL</u>		above Perm. Datum	
Drilling Measured From: <u>GROUND LEVEL</u>			
API Serial No. N/A	Section 17	Township 28S	Range 22E

Logging Date	21-NOV-2002		
Run Number	ONE		
Depth Driller	240 ft		
Schlumberger Depth	240 ft		
Bottom Log Interval	232 ft		
Top Log Interval	19 ft		
Casing Driller Size @ Depth	11.500 in	@	20 ft
Casing Schlumberger	19 ft		
Bit Size	10.625 in		
Type Fluid In Hole	BAROID QWIK GEL		
Density	Viscosity	9.25 lbm/gal	
Fluid Loss	PH		
Source Of Sample	TANK		
RM @ Measured Temperature	7.620 ohm.m	@	75 degF
RMF @ Measured Temperature	6.780 ohm.m	@	72 degF
RMC @ Measured Temperature	5.650 ohm.m	@	73 degF
Source RMF	RMC	MUD PRESS	MUD PRESS
RM @ MRT	RMF @ MRT	5.836 @ 100	5.002 @ 100
Maximum Recorded Temperatures	100 degF		
Circulation Stopped	Time	21-NOV-2002	12:15
Logger On Bottom	Time	21-NOV-2002	14:34
Unit Number	Location	2220	BAKERSFIELD
Recorded By	LIZ STAPLETON		
Witnessed By	PAUL VAN MIDDLESWORTH		



VALLEY WASTE DISPOSAL
 CYM-19H1
 CYMRIC
 KERN
 State: CALIFORNIA

PLATFORM EXPRESS
ARRAY INDUCTION/SP
DENSITY/NEUTRON/GR

Field: CYMRIC
 Location: 1500' S & 130' W
 Well: CYM-19H1
 Company: VALLEY WASTE DISPOSAL

LOCATION
 1500' S & 130' W
 FROM THE NE CORNER OF SECTION 19

Permanent Datum: GROUND LEVEL
 Log Measured From: DRILL FLOOR
 Drilling Measured From: DERRICK

API Serial No. N/A Section 19 Township 28S Range 22E

Logging Date: 11-08-2002

Run Number: ONE

Depth Driller: 245 ft

Schumber Depth: 249 ft

Bottom Log Interval: 241 ft

Top Log Interval: 45 ft

Casing Driller Size @ Depth: 11.875 in @ 45 ft

Bit Size: 10.625 in

Type Fluid in Hole: BAROID QUIK-GEL

Density: 9.25 lbm/gal

Viscosity: PH

Source Of Sample: FLOWLINE

RM @ Measured Temperature: 3.660 ohm.in @ 75 degF

RM @ Measured Temperature: 2.100 ohm.in @ 65 degF

RM @ Measured Temperature: 4.650 ohm.in @ 65 degF

Source RMF: RMF @ MRT

RM @ MRT: 3.297 @ 84 1.660 @ 84

Maximum Recorded Temperature: 84 degF

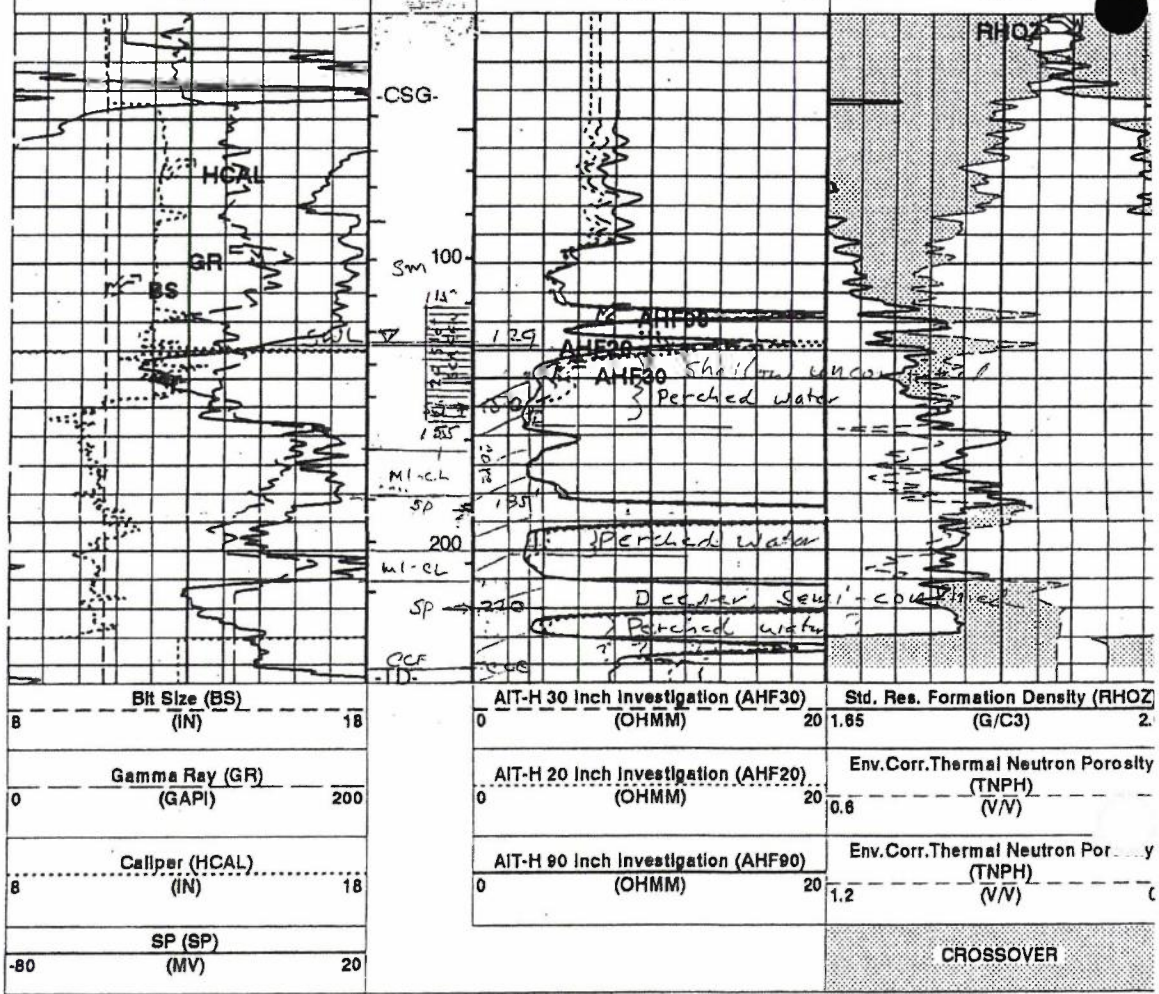
Circulation Stopped: 11-08-2002 15:30

Logger On Bottom: 11-08-2002 17:00

Unit Number: 3146 Location: BAKERSFIELD

Recorded By: SARAH JACOBSON

Witnessed By: PAUL VANMIDDLEWORTH



Company: VALLEY WASTE DISPOSAL

Well: CYM-21D1

Field: CYMRIC

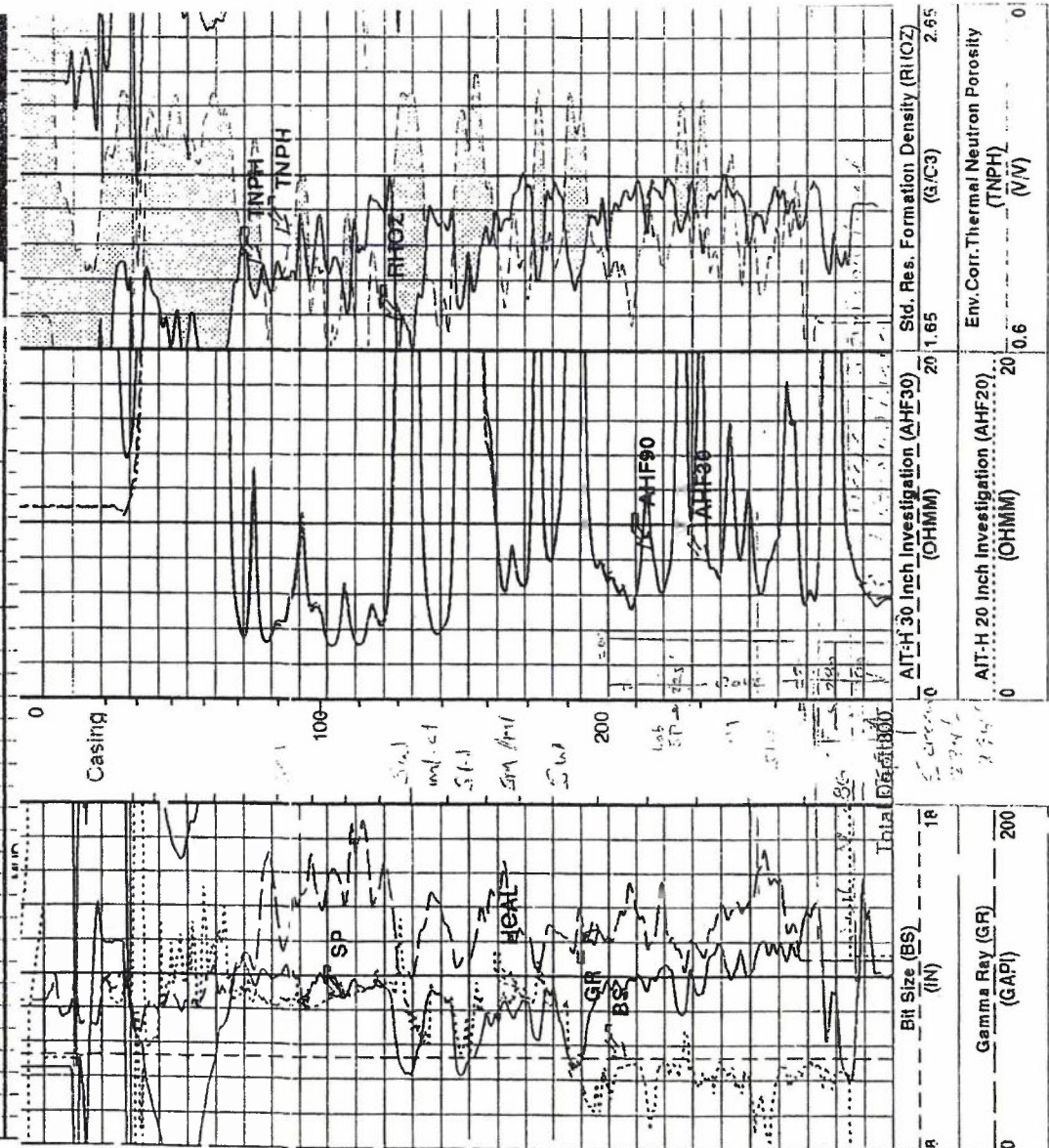
County: KERN

State: CALIFORNIA


ARRAY INDUCTION/SP
DENSITY/NEUTRON/GRLocation:
Well: CYM-21D1
Company: VALLEY WASTE DISPOSAL


LOCATION		Elev.: K.B.
		G.L.
		D.F.
Permanent Datum:	GROUND LEVEL	Elev.:
Log Measured From:	GROUND LEVEL	above Perm. Datum
Drilling Measured From:	GROUND LEVEL	
API Serial No.	Section 21	Township 29S
		Range 22E


Logging Date: 13-Nov-2002
 Number: 1
 Log Driller: 300 ft
 Schlumberger Depth: 300 ft
 Log Interval: 292 ft
 Log Interval: 20 ft
 Log Driller Size @ Depth: 11.500 in @ 20 ft @
 Log Schlumberger: 20 ft
 Log Size: 10.625 in
 Fluid In Hole: GEL
 Viscosity: 8.25 lbm/gal
 PH:
 Loss:
 Type Of Sample: TANK
 Measured Temperature: 9.400 ohm.m @ 76 degF @
 Measured Temperature: 8.500 ohm.m @ 63 degF @
 Measured Temperature: 5.900 ohm.m @ 65 degF @
 ce RMF RMC PRESS PRESS
 MRT RMF @ MRT 8.683 @ 85 6.462 @ 85 @
 Maximum Recorded Temperatures: 85 degF
 Logging Stopped Time: 13-Nov-2002 15:00
 Log On Bottom Time: 13-Nov-2002 16:15
 Number Location: 2107 BAKERSFIELD
 Logged By: PHILIP GIBICAR
 Checked By: PAUL VAN MIDDLESWORTH




Appendix C

Borehole Construction	Sample		Soil Vapour (ppm)	Depth (Feet)	Geology	Borehole Number: CYM-19H1	Page 1
	Number	Type				Start Date: 11/6/02	Drilling Method: Air Rotary
						Finish Date: 11/9/02	Borehole Diameter: 10 5/8"
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"
					Description	Comments	
				0			
				10		0 - 75' Silt to Silty sand, light brown to tan, fine to very fine, loose, dry	
				20			
				30			
				40			
				50			
				60			
				70			
				80		75 - 80' Hard silty lense- advance casing	
				90		80 - 85' Light brown to tan silt, very fine, loose, <2% fine sand	
				100		90 - 95' Hard silty lense- advance casing (slight color change to brown/greenish-brown)	
Remarks:						<p>Legend</p> <p><input checked="" type="checkbox"/> Disturbed Sample</p> <p><input type="checkbox"/> Undisturbed Sample</p> <p>* Headspace Analysis</p> <p>† Down Borehole Analysis</p> <p>▼ Groundwater Table</p> <p>▽ Perched Water Table</p>	
						<p>Borehole Log</p> <p>Job Title:</p> <p>Location: Cymric</p> <p>Client: VWD</p> <p>TI App'd:</p> <p>Ref.:</p> <p>Date:</p> <p>Job No.:</p>	
						 <p>Geomega</p>	

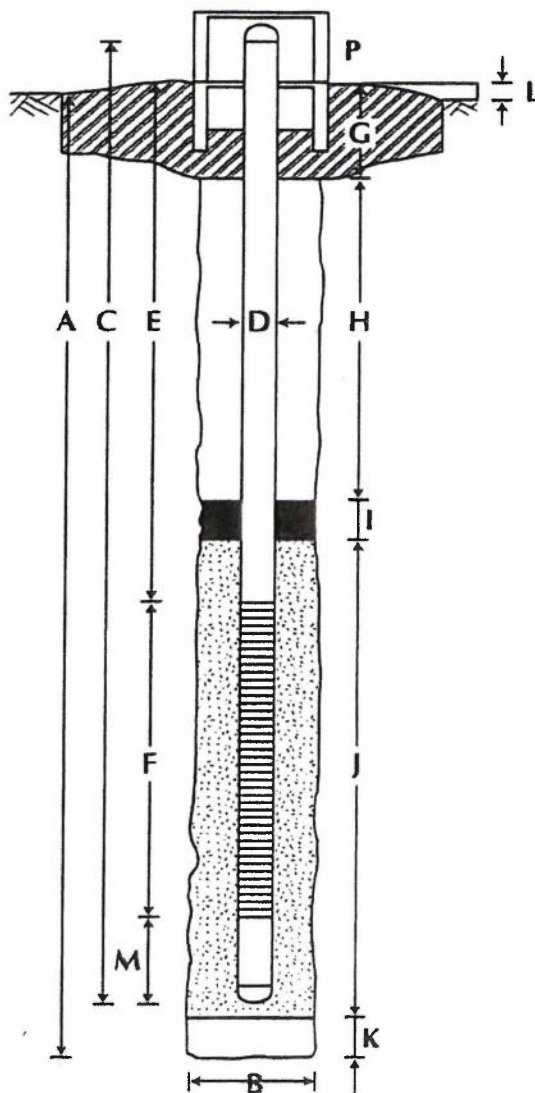
Borehole Construction	Sample		Soil Vapour (ppm)	Depth (Feet)	Geology	Borehole Number: CYM-19H1	Page 2
	Number	Type				Start Date: 11/6/02	Drilling Method: Air Rotary
						Finish Date: 11/9/02	Borehole Diameter: 10 5/8"
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"
					Description	Comments	
					100	100 - 105' Silt, very hard, greenish-brown, dry Chunks of hard silt in cuttings, some nodules of gypsum inside silt chunks, <5% chert pebbles.	
					110		
					120		
					130	125 - 130' Sand, very fine to fine, subround, poorly sorted, moist	
					140	135' Very fine sand with 50% silt, sorted with minor biotite flakes, wet, clumpy (sands becoming coarser as hole is cleaned out)	
					150	Switch drilling to mud rotary @ 140'.	
					160		
					170		
					180		
					190		
					200		
Remarks: Drive casing to 140'; blow-out hole and wait 10 min. to see if water collects in hole. No water collects after 10 min. Switch mud rotary @ 140'.						<div> <div> Legend </div> <div> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table </div> </div> <div> <div>Borehole Log</div> <div> Job Title: Location: Cymric Client: VWD </div> <div> TI App'd: Ref.: Date: Job No.: </div> <div>  Geomega </div> </div>	

Borehole Construction	Sample		Recovery (feet)	Depth (Feet)	Geology	Borehole Number: CYM-19H1	Page 3		
	Number	Type				Start Date: 11/6/02	Drilling Method: Mud Rotary		
						Finish Date: 11/9/02	Borehole Diameter: 10 5/8"		
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC		
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"		
					Description	Color			
					100				
					110				
					120				
					130				
					140	140 - 152' Sandy beds interbedded with hard sandstone lenses & chert nodules, wet.	Light gray		
0.5									
0.5						(Medium to coarse sand, poor sorting, subangular, loose, wet, <10% medium to coarse gravels, yellow-orange stain @ 152')			
150						152 - 156' Dense clay, stiff, wet	Greenish-gray		
4.6						(Black & orange mottling lenses in clay @ 153-154')			
5						156 - 166' Silty clay, soft to medium stiff, minor chert nodules, minor reddish-orange staining, mottling throughout			
160						166 - 168' Sand to silty sand, <30% silt, very fine, medium dense, minor muscovite flakes, thin interbedded clay lenses	Brownish-gray		
4						168 - 175' Clay, dense, <10% silt, minor reddish brown mottling	Light brownish-gray		
4.4									
170						175 - 180' Silty clay to sandy clay, 20% silt, 30% sand, stiff reddish-brown mottling	Greenish-brown		
2.5									
4.7						181 - 183' Sandstone stringer, very hard- advance with tri-cone			
180						183 - 197' Coarse sand, poor sorting, subangular, loose, wet, Lense of pea-gravel @ 185', well rounded, poor sorting	Light gray to		
3						Layers of dark, fine grained deposits @ 188-190' & 193-196'	Yellowish-brown		
4.8						197 - 198' Clay, soft, high plasticity, reddish-orange mottling	Yellow-brown		
190						198 - 204' Silty clay, medium stiff, abundant muscovite flakes @ 198 - 200'	Light brown		
5									
5									
200									
Remarks:						Borehole Log			
						Job Title:			
						Location: Cymric			
						Client: VWD			
						TI App'd:			
						Ref.:			
						Date:			
<div> <div> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample </div> <div> <input type="checkbox"/> * Headspace Analysis <input type="checkbox"/> † Down Borehole Anaysis </div> <div> <input type="checkbox"/> Groundwater Table <input type="checkbox"/> Perched Water Table </div> </div>						Job No.:			
						 Geomega			

Borehole Construction	Sample		Recovery (feet)	Depth (Feet)	Geology	Borehole Number: CYM-19H1	Page 4
	Number	Type				Start Date: 11/6/02	Drilling Method: Mud Rotary
						Finish Date: 11/9/02	Borehole Diameter: 10 5/8"
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"
					Description	Color	
200							
5					204 - 206' Clay, stiff, dark mottling	Yellowish-brown	
5							
210					206 - 225' Sand, medium to coarse, poor sorting, subrounded, loose to medium dense, subround, loose	Light gray	
4.8						with	
3.5					(<30% very coarse grains, reddish-orange quartz grains)	reddish-orange	
220					(10% medium grains, granite grains & muscovite flakes)	coarse grains	
4.7					(Dark, fine-grained interbedded lenses throughout)		
0.5							
230					225 - 236' Sand, fine to medium, well sorted, medium dense, abundant mica flakes	Brownish-gray	
					(dark fine grained interbedded lenses throughout)		
240					236 - 239' Sand, medium to coarse, poor sorting, subround, loose	Yellowish-brown	
					239 - 245' Clay, dense, stiff, dark mottled speckles	Light olive to Olive brown	
250					TD = 245'		
260							
270							
280							
290							
300							
Remarks:					<u>Legend</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table		
					Borehole Log		
					Job Title:		
					Location: Cymric		
					Client: VWD		
					TI App'd: Ref.: Date: Job No.:		
 Geomega							


Geomega MONITORING WELL CONSTRUCTION LOG

Geomega Project Number		Boring/Well Number	CYM-19H1
Project Name.....	VWD-Cymric	Top of Casing Elevation (at Mark)	No Survry Data
Project Location.....	Cymric, CA	Ground Surface Elevation.....	No Survry Data
Well Permit Number.....	NA	Datum.....	No Survry Data
Date Started.....	11/9/02	Date Finished.....	11/10/02
Notes.....			





Exploratory Boring


A. Total Depth (feet).....	245'
B. Diameter (inches).....	11 7/8"
Drilling Method.....	Air Rotary/Mud Rotary

Well Construction


C. Casing Length (feet).....	165'
Material.....	Schedule 80 PVC
D. Diameter (inches).....	5"
E. Depth to Top of Perforations (feet)	115'
F. Perforated Length (feet).....	40'
Perforated Interval (feet)	115' - 155'
Blank section (feet):.....	-----
Perforated Type.....	Factory-slotted PVC
Perforated Size (inches).....	0.020"
G. Surface Grout (feet).....	
Materials.....	
H. Backfill (feet).....	0' - 104'; 180' - 245'
Backfill Material.....	10:1, I/I Cement:Bentonite Chips
I. Bentonite Seal (feet).....	104' - 110'
Material.....	Baroid Holeplug, 3/8" bentonite chips
J. Filter Pack (feet).....	110' - 153'
Pack Material/Size.....	Monterey Sand, #3
K. Bottom Zone if Needed (feet).....	153' - 180'
Material.....	Oglebay Norton Sand, 8-16
L. Surface Cover.....	~4" Concrete Mix
M. Silt Trap Length (feet).....	155' - 165' (10')
N. Well Centralizer Locations (feet)...	65', 115', 165'
P. Surface Monument.....	10 5/8" Stovepipe, 3' above grade
Monument Cover.....	10" Aluminum Locking Cover

Borehole Construction	Sample		Soil Vapour (ppm)	Depth (Feet)	Geology	Borehole Number: CYM-17N1	Page 1
	Number	Type				Start Date: 11/19/02	Drilling Method: Air Rotary
						Finish Date: 11/22/02	Borehole Diameter: 10 5/8"
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"
					Description	Color	
					0 - 20' Silt, very fine, loose, dry	Yellowish-brown to Tan	
					20 - 40' Silt to silty clay, fine, medium stiff, dry (minor remnants/grains of gypsum in dry floury silty clay.)	Light Brown	
					40 - 60' Clay to silty clay, very fine, medium stiff, dry (abundant gypsum crystals in floury clay.)	Yellowish-brown	
					60 - 70' Clay to silty clay, medium stiff, dry (abundant gypsum crystals)	Pale Yellowish brown	
					70 - 80' Silty clay to sandy silt, stiff, fine grained, 20% fine sand slightly moist (cuttings beginning to ball)	Yellowish-brown to Brown	
					80 - 90' Silty clay to clay, stiff to hard, increasing moisture (abundant gypsum crystals)	Reddish-Brown	
					90 - 100' Silty clay to sandy silt, hard, 10% fine sand, moist	Dark Yellowish-brown	
Remarks:					<u>Legend</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table		
					Borehole Log Job Title: Location: Cymric Client: VWD TI App'd: Ref.: Date: Job No.:		
					 Geomega		

Borehole Construction	Sample		Soil Vapour (ppm)	Depth (Feet)	Geology	Borehole Number: CYM-17N1	Page 2
	Number	Type				Start Date: 11/19/02	Drilling Method: Air Rotary
						Finish Date: 11/22/02	Borehole Diameter: 10 5/8"
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"
					Description	Color	
				100	100 - 115' Clay, hard to very hard, moist Thin (<1") moist sandy lenses interbedded with hard, dry clay lenses	Dark Yellowish-brown	
				110	115 - 118' Fine to medium sand, dry, angular, poor sorting, 10% clay, 10% coarse gravel	Light Brown to	
				120	(coarse sand @ 118', poor sorting) 118 - 120' Sand, fine to medium, well sorted, moist, subround.	Light Gray	
(Moist @ 125')				120	120 - 125' Sand, medium to coarse, well sorted, subround, very dense, moist to wet.	Dark Gray	
(Wet @ 130')				130	125 - 130' Silty sand, medium to coarse, poor sorted, dense, wet	Olive brown	
				130	130 - 135' Sandy clay to clay, hard, <5% sand, wet .	Yellowish-brown	
				140	135 - 140' Clay to silty clay, hard, 20% silt, wet.		
				140	(Switch to Mud Rotary with 94mm coring barrel @ 140')		
				150			
				160			
				170			
				180			
				190			
				200			
Remarks: Hole caved from 120 to 140' while tripping in coring tool. Switch to mud rotary @ 140'.						<div> <div> <div>Legend</div> <div> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table </div> </div> <div> <div>Borehole Log</div> <div>Job Title:</div> <div>Location: Cymric</div> <div>Client: VWD</div> <div>TI App'd:</div> <div>Ref.:</div> <div>Date:</div> <div>Job No.:</div> </div> <div>  <div>Geomega</div> </div> </div>	

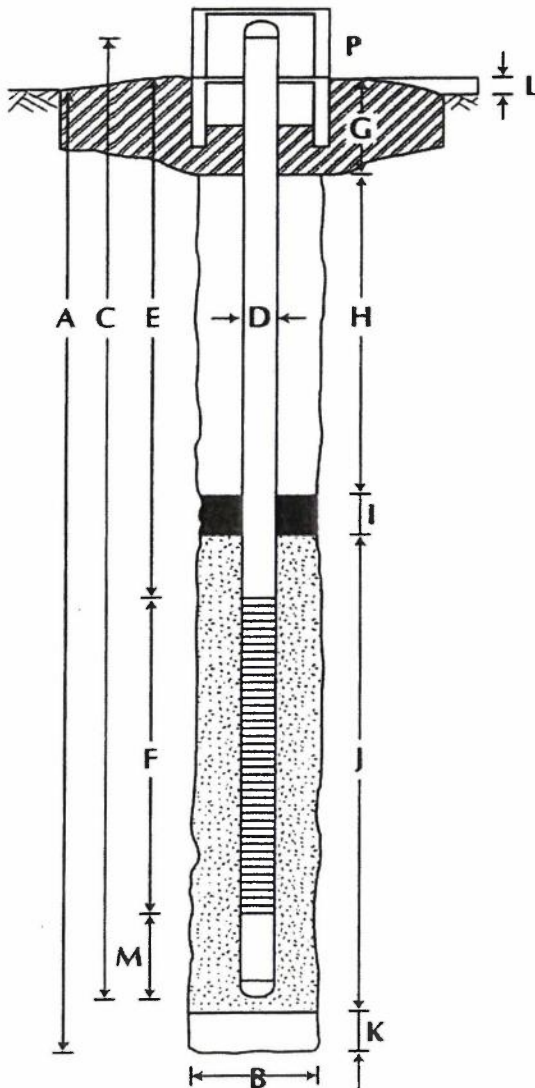
Borehole Construction	Sample		Recovery (feet)	Depth (Feet)	Geology	Borehole Number: CYM-17N1	Page 3	
	Number	Type				Start Date: 11/19/02	Drilling Method: Mud Rotary	
						Finish Date: 11/22/02	Borehole Diameter: 10 5/8"	
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC	
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"	
					Description	Color		
				100				
				110				
				120				
				130				
				140	140 - 148' Silty clay, soft, minor mica, orange stain patches Gravels @ 145-146' (interbedded with soft silty sand lenses)	Yellowish-brown		
				2				
				2.6	148 - 151' Silty clay, hard, minor mica flakes			
				150	151 - 154.5' Silty sand to sand, fine to medium, poor sorting, moist	Grayish-brown		
				5	154.5 - 157' Clay, dense, minor coarse gravels, hard, dark mottling	Olive Brown		
				4	157 - 159' Sand to silty sand, fine to medium, well rounded, well sorted (interbedded with lenses or darker fines)	Reddish-brown		
				160	159 - 161' Clay, dense, hard, dark mottling patches			
				4.5	161 - 163' Silty clay, hard, dark mottling patches, minor gypsum	Light Grayish-brown		
				2.2	163 - 166' Sand, fine to medium, minor silt, iron staining, wet (interbedded with coarse sand lenses, poor sorting, minor mica)			
				170	166 - 168' Clay, soft, minor mica, wet (thin lenses of silty sand)			
				5.2	168 - 170' Silty clay, very hard, minor gypsum crystals, dry	Reddish-brown		
				4	170 - 174' Clay, dense, hard, dry	Grayish-brown		
				180	174 - 175' Sandy silt, soft, poor sorting, minor mica flakes			
				5.5	175 - 177' Silty-sandy clay, fine to medium, poor sorting, moist, abundant mica flakes, iron staining, (thin lenses of dark fines)	Pale Olive Brown		
				5.5	177 - 180' Sand to silty sand, abundant mica flakes, poor sorting (interbedded with soft clay lenses)			
				190				
				5.3				
				5				
				200				
Remarks:					<u>Legend</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis ▼ Groundwater Table ▽ Perched Water Table		Borehole Log	
							Job Title:	
							Location: Cymric	
							Client: VWD	
							TI App'd:	
							Ref.:	
Date:								
Job No.:		 Geomega						

Borehole Construction	Sample		Recovery (feet)	Depth (Feet)	Geology	Borehole Number: CYM-17N1	Page 4
	Number	Type				Start Date: 11/19/02	Drilling Method: Mud Rotary
						Finish Date: 11/22/02	Borehole Diameter: 10 5/8"
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"
				200		Description	Color
(Wet @ 210')			4.8		180 - 187' Silty clay to clay, medium dense	Pale Olive Brown	
			5.2		(interbedded with dense clay lenses)		
					(Very fine sandy silt layer @ 183-185', abundant mica, soft)		
				210	187 - 190' Dense clay, abundant gypsum crystals, very dense	Olive-Brown	
			1.2		190 - 197' Clay, medium hard, dry		
			2.2		(interbedded with very fine sandy-silt lenses, minor mica flakes)		
				220	197 - 202' Sandy-silty clay, very fine grained, medium dense, dry	Light Brown to Grayish Brown	
			1.8		(minor iron staining & dark mottling)		
			5.5		202 - 205' Sand, fine, loose, well sorted, dry		
				230	(thin lenses of dark fines, abundant mica flakes)	Olive-Brown	
			5.2		205 - 207' Sand, medium, loose, poor sorting		
			5.5		(thin lenses of dark fines, abundant mica flakes)		
				240	207 - 209' Sandy-silty clay, medium dense, minor gypsum, dry	Yellowish Brown	
					209 - 224' Sand, fine to medium, loose, subround, poor sorting		
					(minor coarse sands, lenses of dark fines, sorted in places)		
			250	224 - 232' Clay, very dense, dark mottling, dry	Dark Olive		
				232 - 235' Silty clay, hard, dark mottling, dry			
				235 - 240' Clay, dense, hard, dark mottling, dry			
			260	TD = 242'			
			270				
			280				
			290				
			300				

Remarks:	Legend		Borehole Log	
	<input checked="" type="checkbox"/>	Disturbed Sample	Job Title:	
	<input type="checkbox"/>	Undisturbed Sample	Location: Cymric	
	*	Headspace Analysis	Client: VWD	
	†	Down Borehole Analysis	TI App'd:	
	▽	Groundwater Table	Ref.:	
▽	Perched Water Table	Date:		
		Job No.:		

Geomega MONITORING WELL CONSTRUCTION LOG

Geomega Project Number		Boring/Well Number	CYM-17N1
Project Name.....	VWD-Cymric	Top of Casing Elevation (at Mark)	No Survry Data
Project Location.....	Cymric, CA	Ground Surface Elevation.....	No Survry Data
Well Permit Number.....	NA	Datum.....	No Survry Data
Date Started.....	11/21/02	Date Finished.....	11/22/02
Notes.....			



Exploratory Boring

A. Total Depth (feet).....	240'
B. Diameter (inches).....	11 7/8"
Drilling Method.....	Air Rotary/Mud Rotary

Well Construction

C. Casing Length (feet).....	175'
Material.....	Schedule 80 PVC
D. Diameter (inches).....	5"
E. Depth to Top of Perforations (feet)	105'
F. Perforated Length (feet).....	60'
Perforated Interval (feet)	105' - 165'
Blank section (feet):.....	-----
Perforated Type.....	Factory-slotted PVC
Perforated Size (inches).....	0.020"
G. Surface Grout (feet).....	
Materials.....	
H. Backfill (feet).....	0' - 93'
Backfill Material.....	10:1, I/II Cement:Bentonite Chips
I. Bentonite Seal (feet).....	93' - 99'
Material.....	Baroid Holeplug, 3/8" bentonite chips
J. Filter Pack (feet).....	99' - 180'
Pack Material/Size.....	Oglebay Norton Sand, #3
K. Bottom Zone if Needed (feet).....	180' - 240'
Material.....	3/8" bentonite chips
L. Surface Cover.....	Concrete Vault
M. Silt Trap Length (feet).....	165' - 175' (10')
N. Well Centralizer Locations (feet)...	50' intervals
P. Surface Monument.....	
Monument Cover.....	

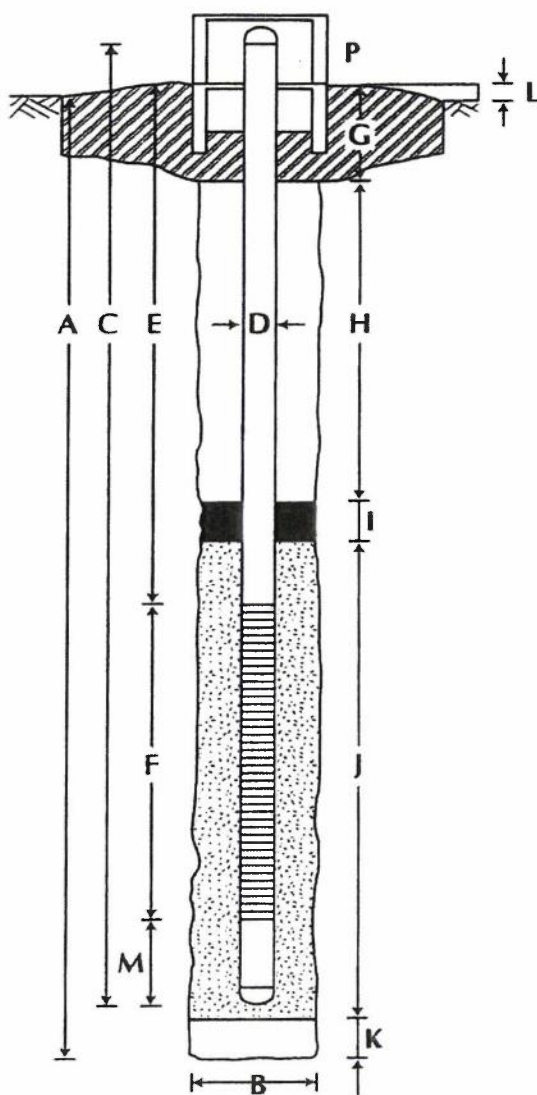
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Borehole Construction	Sample		Soil Vapour (ppm)	Depth (Feet)	Geology	Borehole Number: CYM-21D1	Page 2
	Number	Type				Start Date: 11/11/02	Drilling Method: Air Rotary
						Finish Date: 11/19/02	Borehole Diameter: 10 5/8"
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"
					Description	Color	
					100	Continue to advance casing through hard silty clay @ 100 - 120'	Greyish Brown to Olive Brown
					110	100 - 120' Clay to silty clay, hard, moist (abundant gypsum crystals)	
					120	120 - 130' Clay to silty clay, hard, moist	Light Gray
					130	130 - 140' Sand, very fine to fine, loose, moist (<10% coarse sand)	
					140	140 - 145' Silty clay, hard, moist	Brown
					150	145 - 155' Sand to silty sand, very fine to fine, loose, moist (10% coarse sand, <5% silt)	Yellowish Brown
					160	155 - 160' Sand, very fine, loose, moist	Dark Brown
					170	160 - 170' Silty clay to clay, hard, moist	
					180	170 - 180' Silty sand, fine to medium, hard, moist (10% medium sand, 20% silt)	Brownish Yellow
					190	180 - 190' Silty sand, very fine to fine, hard, moist	
					200	190 - 200' Sand to silty sand, fine to medium, medium hard, moist	
					Switch drilling to mud rotary @ 200'		
Remarks: Pull back drill bit @ 165-170' and leave hole open for 15 min. to see if water accumulates. After 15 min., blow-out hole. No water accumulation- Dry. Continue drilling with air to 200'.						Borehole Log Job Title: _____ Location: _____ Client: _____ TI App'd: _____ Ref.: _____ Date: _____ Job No.: _____	
Legend <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Analysis Groundwater Table Perched Water Table							

Borehole Construction	Sample		Recovery (feet)	Depth (Feet)	Geology	Borehole Number: CYM-21D1	Page 3
	Number	Type				Start Date: 11/11/02	Drilling Method: Mud Rotary
						Finish Date: 11/19/02	Borehole Diameter: 10 5/8"
						Driller: Water Development	Screen Type & Diameter: 5" Sch. 80 PVC
						Logged by: Paul VanMiddlesworth	Screen Slot Size: 0.020"
					Description		Color
(Moist @ 210')			200		200 - 206' Silty clay, stiff to hard, moist, minor mica flakes	Yellowish Brown	
			3.6		206 - 210' Clay, dense, stiff, moist, dark mottling patches	Pale Olive	
			5.8		210 - 212' Silty clay, soft		
			210		212 - 218' Sandy-silty clay, medium stiff to soft, minor mica, moist		
			5.5				
			5.4		218 - 221' Clay to silty clay, medium dense.		
			220		221 - 225' Silty clay, hard layers interbedded with soft lenses	Yellowish Brown	
			5				
			4.5		225 - 230' Sand, medium, loose, poor sorting, subround, moist (20% coarse sand, minor mica flakes)	Light Gray	
			230		230 - 233' Sandy silt, very fine, medium dense, abundant mica.	Yellowish Brown	
			4.9		233 - 235' Medium sand, subround, dry		
			2.8		235 - 238' Silty clay, soft to medium dense, moist	Pale Olive	
			240		238 - 242' Clay, dense, high plasticity, very stiff, dry		
			5.1		242 - 244' Sand to silty sand, fine to medium, loose, dry		
	(Moist @ 275')			2.1		poor sorting, 50% silt in places.	
			250		244 - 250' Silty-sandy clay, medium dense, dry		
			5.3		250 - 258' Sandy clay to silty clay, medium dense, minor mottling (dense clay layers interbedded with soft silty lenses)	Olive Brown	
			5				
			260		258 - 268' Silty clay, soft to medium stiff, abundant mica, moist (Thin lenses of fine sand @ 259-260')	Yellow Brown	
(Wet @ 278')			3.1				
			4.4		268 - 274' Clay, dense, very stiff, minor dark mottling, iron stains (dense clay layers interbedded with soft silty lenses)	Pale Olive	
			4.4				
			4.5		274 - 287' Sand, fine to medium, medium dense, poor sorting, subrounded to angular, moist, abundant mica flakes (thin lenses of coarse sands)	Light Gray to Brownish Gray	
			280		287 - 293' Silty clay, minor fine sands, abundant mica, stiff	Olive Brown	
		4.7					
		5		293 - 300' Clay, dense, hard, dry, black mottling throughout	Dark Olive		
		5.4					
		5.2		TD = 300'			
Remarks:					<u>Legend</u> <input checked="" type="checkbox"/> Disturbed Sample <input type="checkbox"/> Undisturbed Sample * Headspace Analysis † Down Borehole Anaysis Groundwater Table Perched Water Table		
					Borehole Log Job Title: Location: Client: TI App'd: Ref.: Date: Job No.:		

Geomega MONITORING WELL CONSTRUCTION LOG

Geomega Project Number		Boring/Well Number	CYM-21D1
Project Name.....	VWD-Cymric	Top of Casing Elevation (at Mark)	No Survry Data
Project Location.....	Cymric, CA	Ground Surface Elevation.....	No Survry Data
Well Permit Number.....	NA	Datum.....	No Survry Data
Date Started.....	11/14/02	Date Finished.....	11/19/02
Notes.....			



Exploratory Boring

A. Total Depth (feet).....	300'
B. Diameter (inches).....	11 7/8"
Drilling Method.....	Air Rotary/Mud Rotary

Well Construction

C. Casing Length (feet).....	299'
Material.....	Schedule 80 PVC
D. Diameter (inches).....	5"
E. Depth to Top of Perforations (feet)	274'
F. Perforated Length (feet).....	20'
Perforated Interval (feet)	274' - 294'
Blank section (feet):.....	-----
Perforated Type.....	Factory-slotted PVC
Perforated Size (inches).....	0.020"
G. Surface Grout (feet).....	
Materials.....	
H. Backfill (feet).....	0' - 265'
Backfill Material.....	10:1, I/II Cement:Bentonite Chips
I. Bentonite Seal (feet).....	258' - 265'
Material.....	Baroid Holeplug, 3/8" bentonite chips
J. Filter Pack (feet).....	265' - 299'
Pack Material/Size.....	Oglebay Norton Sand, #3
K. Bottom Zone if Needed (feet).....	299' - 300'
Material.....	3/8" bentonite chips
L. Surface Cover.....	~4" Concrete Mix
M. Silt Trap Length (feet).....	294' - 299' (5')
N. Well Centralizer Locations (feet)...	50' intervals
P. Surface Monument.....	10 5/8" Stovepipe, 3' above grade
Monument Cover.....	10" Aluminum Locking Cover

ENVIRONMENTAL HEALTH SERVICES DEPARTMENT

STEVE McCALLEY, R.E.H.S., Director
1001 STREET, SUITE 300
BAKERSFIELD, CA 93301-2370
TEL: (661) 862-8700
FAX: (661) 862-8701
TOLL FREE RELAY: (800) 735-2929
EMAIL: eh@co.kern.ca.us



RESOURCE MANAGEMENT AGENCY

DAVID PRICE III, RMA DIRECTOR
Community Development Program Department
Engineering & Survey Services Department
Environmental Health Services Department
Planning Department
Roads Department

November 1, 2002

Valley Waste Disposal Company
1400 Easton Drive, Suite 139-B
Bakersfield, CA 93309

Ladies and Gentlemen:

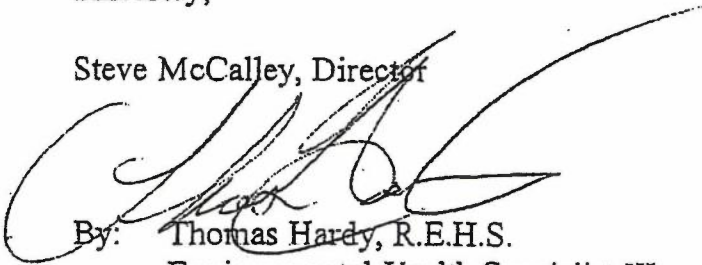
This is to advise you that your application for a permit to construct a monitoring well located on APN 099-290-08, T29S, R22E, Section 19-H, has been received and reviewed. Your permit number is EH-1435.

No additional conditions will be required at this time.

If you have any questions about your well, please contact our office at (661) 862-8700.

Sincerely,

Steve McCalley, Director

By:  Thomas Hardy, R.E.H.S.
Environmental Health Specialist III
Water Quality Program

TH:jrw

cc: Water Development Corp.
File EH-1435

(water/hardy/eh1435-w23b)

ENVIRONMENTAL HEALTH SERVICES DEPARTMENT

RESOURCE MANAGEMENT AGENCY

STEVE McCALLEY, R.E.H.S., Director
2700 "M" STREET, SUITE 300
BAKERSFIELD, CA 93301-2370
Tel: (661) 862-8700
Fax: (661) 862-8701
TTY Relay: (800) 735-2929
e-mail: eh@co.kern.ca.us



DAVID PRICE III, RMA DIRECTOR
Community Development Program Department
Engineering & Survey Services Department
Environmental Health Services Department
Planning Department
Roads Department

November 5, 2002

Valley Waste Disposal Company
1400 Easton Drive, Suite 139-B
Bakersfield, CA 93309

Ladies and Gentlemen:

This is to advise you that your applications for permits to construct two monitoring wells have been received and reviewed. The well locations and permit numbers are as follows:

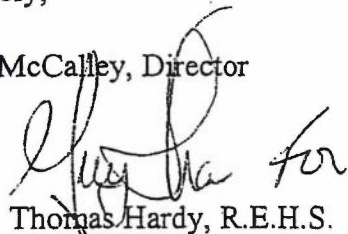
<u>Permit No.</u>	<u>APN</u>	<u>Township, Range, Section</u>
EH-1436	099-290-03	T29S, R22E, Section 17-N
EH-1437	099-290-06	T29S, R22E, Section 21-D

No additional conditions will be required at this time.

If you have any questions about your wells, please contact our office at (661) 862-8700.

Sincerely,

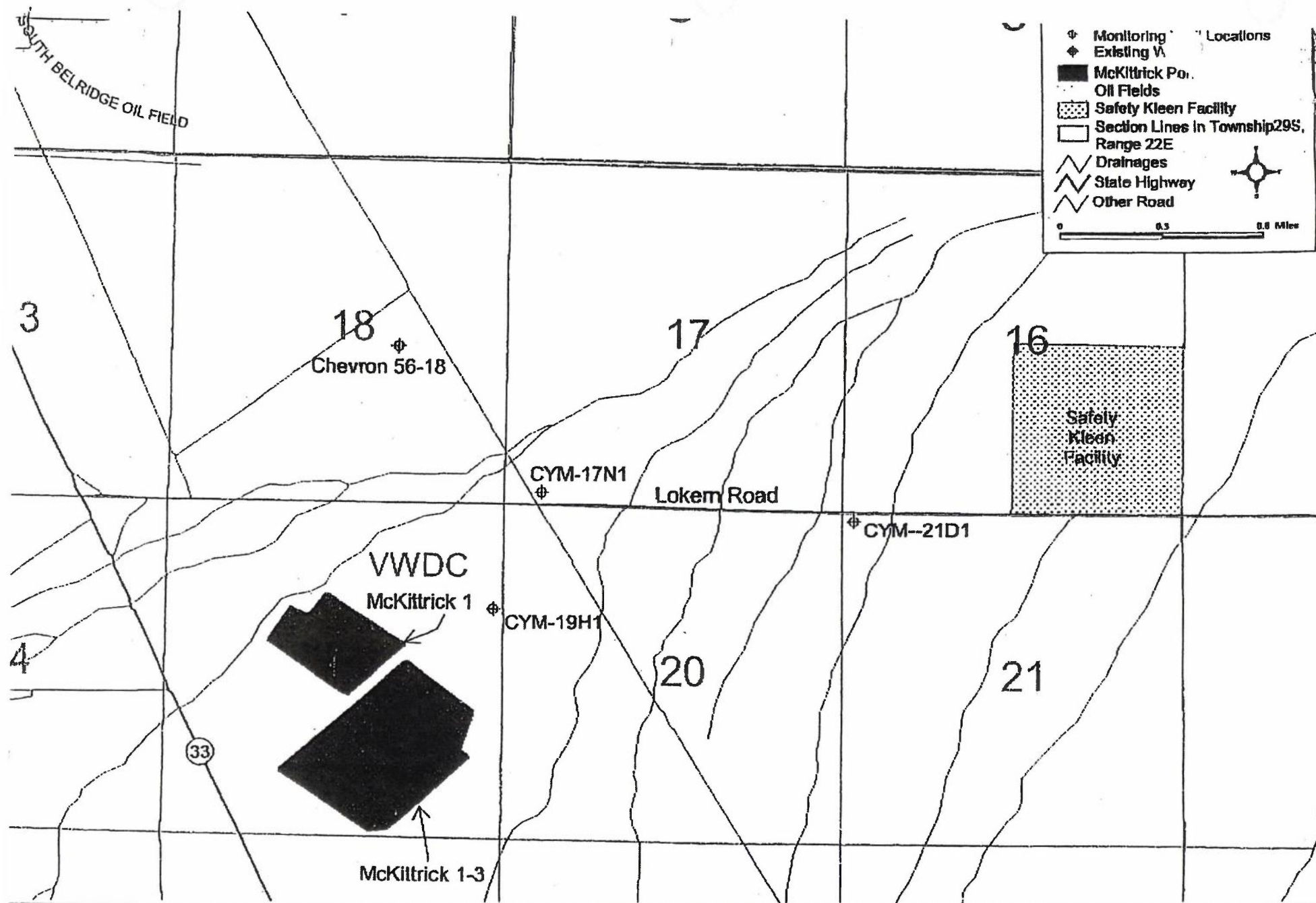
Steve McCalley, Director

By:  Thomas Hardy, R.E.H.S.
Environmental Health Specialist III
Water Quality Program

TH:jrw

cc: Water Development Corp.
Files EH-1436 and EH-1437

(water\hardy\eh1436-w23b)



Generation
Date:
10/25/02

Figure 1. Location map, Valley Waste Disposal Company, Cymric Field.

Kern County
Environmental Health Services Department
2700 "M" Street, Suite 300
Bakersfield, CA 93301
Phone (661) 862-8700
FAX (661) 862-8701



Permit # EH-1435

CYM-19H1

APPLICATION FOR PERMIT TO CONSTRUCTION, RECONSTRUCT, DEEPEN OR DESTROY A WELL

APPLICATION DATE: 10/29/02 PROPOSED START DATE 11/6/02
OWNER: Valley Waste Disposal Company Phone: 661.322.5004
Mailing Address: 1400 Easton Dr, S139-B City Bakersfield Zip: 93309
DRILLING Contractor's
CONTRACTOR Water Development Corp. License 285326 Phone: 530.662.2829
Address: P.O. Box 141 City: Zamora Zip: 95698
SUBCONTRACTOR: Geomug & Inc Phone: 303.443.9117
Address: 2995 Baseline Rd, 3202 City: Boulder, CO Zip: 80303

JOB SITE: T 295 R 22E Sec. 19 40 Acre Sub H
PROPERTY DESCRIPTION: Assessor's Parcel No.: 99-290-08
SITE ADDRESS if available: NE of intersection Hwy 33 & Lakern Rd TOTAL ACRES: < 1
DIRECTIONS to Well Site: West on Lakern Rd, 1.5 miles past Safety Klean facility.
Turn South on dirt road. Follow road 1/2 mile to well site.
See attached maps.

TYPE OF WORK TO BE DONE: (check one) ☒ New Well ☐ Deepen
☐ Reconstruction ☐ Destruction

INTENDED USE:

- ☐ Domestic/private (1 connection)
☐ Domestic/nonpublic (2-4 connections)
☐ Domestic/public (5 or more conn.)
☐ Agricultural
☐ Test Hole
☒ Monitoring
☐ Cathodic Protection
☐ Other _____

CONSTRUCTION METHOD:

- ☐ Reverse Rotary
☐ Rotary
☒ Air Rotary
☐ Other used rotary

SEALING MATERIAL (check one)

- ☐ Neat Cement
☒ Cement Grout
☐ Concrete
☐ Other _____

GRAVEL PACK: (check one)

- ☒ Yes ☐ No
From 170 To 230 Feet

PROPOSED CASING:

Type PVC
Diameter 5" OD
Gauge/Wall sch 80
Conductor Depth 50'

PROPOSED WELL CONSTRUCTION (DEPTH)

Max. 275 Feet
Min. _____ Feet

PROPOSED PERFORATIONS OR SCREEN:

From 170 To 230 Feet
From _____ To _____ Feet

PROPOSED ANNULAR SEAL DEPTH:

Unconsolidated Bent pellets
Hardrock 60-170 feet

PENETRATES TWO OR MORE AQUIFERS

☐ Yes ☒ No

PROPOSED WELL DESTRUCTION SEAL DEPTH

DEPTH OF WELL TO BE DESTROYED _____

GENERAL CONDITIONS:

1. Permit applications will be submitted to the Planning Department for zoning, access, and flood plain clearances prior to approval of the Environmental Health Services Department. If you are drilling within city's limits, you will have to receive approval from their planning department.
Permit applications must be submitted to the Environmental Health Services Department at least ten working days prior to the proposed starting date.
2. Well site approval is required before beginning any work related to well construction. It is unlawful to continue work past the stage at which an inspection is required unless inspection is waived or completed.
4. Other required inspections include: setting conductor casing, E-Logs, all annular seals, and final construction features.
5. In areas where a well penetrates more than one aquifer, and one or more of the aquifers may contain water which is of a quality which may degrade the other aquifer(s) penetrated if allowed to commingle, an E-Log shall be required to determine the location of the confining clay layer(s) and assist in the placement of any required annular seal(s).
6. A phone call to the Department office is required on the morning of the day that work is to commence and 24 hours before the placement of any seals or plugs.
7. Approval of water quality and final construction features is required before the well is put into use.
8. Construction under this permit is subject to any instructions by Department representatives.
9. Any misrepresentation or noncompliance with required permit conditions, or regulations, will result in issuance of a "Stop Work Order."
10. A copy of the Department of Water Resources Driller's Report and water quality analyses must be submitted to the Environmental Health Services Department within 30 days after completion of the work.
11. "Dry" holes must be properly destroyed within two (2) weeks of drilling. A well destruction application must be filed with this Department.
12. The permit is void on the ninetieth (90th) calendar day after date of issuance if work has not been started and reasonable progress toward completion made. Fees are not refundable nor transferable.
13. Lead appurtenances shall not be used in construction of any private or public water supply system. The use of solders containing more than 2/10 of 1% lead is prohibited in making joints and fittings in any private or public potable water system.
14. Permittee shall assume entire responsibility for all activities and uses under this permit and shall indemnify, defend and save the County of Kern and/or Kern County Water Agency, its officers, agents, and employees, free and harmless from any and all expense, cost or liability in connection with or resulting from the exercise of this permit, including, but not limited to, property damage, personal injury, and wrongful death.

I certify that I am the owner of the above-described property, or the authorized representative of such owner, and that all the information I have furnished is current and accurate to the best of my knowledge, and I intend to construct/destroy the well as represented above. I understand that all work is to be done in accordance with Kern County Ordinance Code Chapter 14.08 and Bulletin 74-81 and the conditions of the Permit Application, including any conditions which may be added or changed by the Environmental Health Services Department upon review of this Application and issuance of the Permit. I further understand that any permit issued pursuant to this application is subject to such further conditions as may be deemed necessary to ensure compliance with the permit regulations.

Owner's Signature *[Signature]* Date 10/31/01 Authorized Agent or Agency _____ Date _____

Internal use only Permit Approved: <u><i>[Signature]</i></u> Date: <u>11-1-02</u> Expiration Date: _____		Total Fee: <u>335</u> Date Paid: <u>11-1-02</u> Receipt # _____ <input type="checkbox"/> Cash <input checked="" type="checkbox"/> Check (# _____) Fee received by: <u><i>[Signature]</i></u>	
ZONING Zone: _____ Access Approved: <input type="checkbox"/> Yes <input type="checkbox"/> No Flood Plan Approval Required <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Approved <input type="checkbox"/> Disapproved By: _____ Date: _____		ENVIRONMENTAL HEALTH SERVICES DEPARTMENT E-Log Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NO Gravel Chute Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NO <u><i>[Signature]</i></u>	

REASONS FOR DENIAL OR CONDITIONS OF PERMIT:

Kern County
Environmental Health Services Department
1 "M" Street, Suite 300
Artsfield, CA 93301
Phone (661) 862-8700
FAX (661) 862-8701

Parcel/Map/Tract _____

Parcel No. _____

Assessor's Parcel No. 99-290-03

LOCATION

- A. Indicate below the exact location of well with respect to the following items: property lines, water bodies or courses, drainage pattern, roads, existing wells, structures, sewers or private disposal systems. Include dimensions.

See Attached map.

- B. LOCATION OF WELL WITHIN SECTION LINES - Locate well by measuring from proposed site in relation to section lines or half section lines.

Section No.:

D	C	B	A	1600' 150'
E	F	G	H	
M	L	K	J	
N	P	Q	R	

1- _____ One Mile _____ -1

Kern County
Environmental Health Services Department
2700 "M" Street, Suite 300
Bakersfield, CA 93301
Phone (661) 862-8700
FAX (661) 862-8701



Permit # EH 1436

CYM-17N1

CYM-17N1 = E

APPLICATION FOR PERMIT TO
CONSTRUCTION, RECONSTRUCT, DEEPEN OR DESTROY A WELL

APPLICATION DATE: 10/29/02 PROPOSED START DATE 11/12/02
OWNER: Valley Waste Disposal Company Phone: 661.322.5004
Mailing Address: 1400 Easton Dr, S-139B City Bakersfield Zip: 93309
DRILLING Contractor's
CONTRACTOR Water Development Corp. License 283326 Phone: 530.662.2829
Address: P.O. Box 141 City: Zamora Zip: 95698
SUBCONTRACTOR: Geomega, Inc. Phone: 363.443.9117
Address: 2995 Baseline Rd, 5202 City: Boulder, CO Zip: 80301

JOB SITE: T 29S R 22E Sec. 17 40 Acre Sub N
PROPERTY DESCRIPTION: Assessor's Parcel No.: 99-290-03
SITE ADDRESS if available: Near Intersection of Hwy 33 & Lokern TOTAL ACRES: < 1
DIRECTIONS to Well Site: West on Lokern Road, one mile past Safety Kleen facility. Turn north on dirt road into drill site. See attached map.

TYPE OF WORK TO BE DONE: (check one)

☒ New Well

☐ Reconstruction

☐ Deepen

☐ Destruction

INTENDED USE:

- ☐ Domestic/private (1 connection)
☐ Domestic/nonpublic (2-4 connections)
☐ Domestic/public (5 or more conn.)
☐ Agricultural
☐ Test Hole
☒ Monitoring
☐ Cathodic Protection
☐ Other _____

CONSTRUCTION METHOD:

- ☐ Reverse Rotary
☐ Rotary
☒ Air Rotary
☒ Other Wid Rotary

SEALING MATERIAL (check one)

- ☐ Neat Cement
☒ Cement Grout
☐ Concrete
☐ Other _____

GRAVEL PACK: (check one)

- ☒ Yes ☐ No
From 190 To 250 Feet

PROPOSED WELL
CONSTRUCTION (DEPTH)

Max. 240 Feet
Min. _____ Feet

PROPOSED PERFORATIONS
OR SCREEN:

From 190 To 250 Feet
From _____ To _____ Feet

PROPOSED CASING:

Type PVC
Diameter 5" OD
Gauge/Wall SC480
Conductor Depth 50'

PROPOSED ANNULAR SEAL DEPTH:

Unconsolidated best pellets
Hardrock 180-190

PENETRATES TWO OR MORE
AQUIFERS

☐ Yes ☒ No

PROPOSED WELL DESTRUCTION SEAL DEPTH _____

DEPTH OF WELL TO BE DESTROYED _____

THIS APPLICATION BECOMES A PERMIT WHEN APPROVED

GENERAL CONDITIONS:

1. Permit applications will be submitted to the Planning Department for zoning, access, and flood plain clearances prior to approval of the Environmental Health Services Department. If you are drilling within city's limits, you will have to receive approval from their planning department.
2. Permit applications must be submitted to the Environmental Health Services Department at least ten working days prior to the proposed starting date.
3. Well site approval is required before beginning any work related to well construction. It is unlawful to continue work past the stage at which an inspection is required unless inspection is waived or completed.
4. Other required inspections include: setting conductor casing, E-Logs, all annular seals, and final construction features.
5. In areas where a well penetrates more than one aquifer, and one or more of the aquifers may contain water which is of a quality which may degrade the other aquifer(s) penetrated if allowed to commingle, an E-Log shall be required to determine the location of the confining clay layer(s) and assist in the placement of any required annular seal(s).
6. A phone call to the Department office is required on the morning of the day that work is to commence and 24 hours before the placement of any seals or plugs.
7. Approval of water quality and final construction features is required before the well is put into use.
8. Construction under this permit is subject to any instructions by Department representatives.
9. Any misrepresentation or noncompliance with required permit conditions, or regulations, will result in issuance of a "Stop Work Order."
10. A copy of the Department of Water Resources Driller's Report and water quality analyses must be submitted to the Environmental Health Services Department within 30 days after completion of the work.
11. "Dry" holes must be properly destroyed within two (2) weeks of drilling. A well destruction application must be filed with this Department.
12. The permit is void on the ninetieth (90th) calendar day after date of issuance if work has not been started and reasonable progress toward completion made. Fees are not refundable nor transferable.
13. Lead appurtenances shall not be used in construction of any private or public water supply system. The use of solders containing more than 2/10 of 1% lead is prohibited in making joints and fittings in any private or public potable water system.
14. Permittee shall assume entire responsibility for all activities and uses under this permit and shall indemnify, defend and save the County of Kern and/or Kern County Water Agency, its officers, agents, and employees, free and harmless from any and all expense, cost or liability in connection with or resulting from the exercise of this permit, including, but not limited to, property damage, personal injury, and wrongful death.

I certify that I am the owner of the above-described property, or the authorized representative of such owner, and that all the information I have furnished is current and accurate to the best of my knowledge, and I intend to construct/destroy the well as represented above. I understand that all work is to be done in accordance with Kern County Ordinance Code Chapter 14.08 and Bulletin 74-81 and the conditions of the Permit Application, including any conditions which may be added or changed by the Environmental Health Services Department upon review of this Application and issuance of the Permit. I further understand that any permit issued pursuant to this application is subject to such further conditions as may be deemed necessary to ensure compliance with the permit regulations.

Owner's Signature *[Signature]* Date 10/31/02 Authorized Agent or Agency Date _____

<p><i>Internal use only</i></p> <p>Permit Approved: <u><i>[Signature]</i></u></p> <p>Date: <u>11-1-02</u></p> <p>Expiration Date: _____</p>	<p>Total Fee: <u>375</u> Date Paid: <u>11-1-02</u></p> <p>Receipt # _____ <input type="checkbox"/> Cash <input type="checkbox"/> Check (# _____)</p> <p>Fee received by: <u><i>[Signature]</i></u></p>
<p style="text-align: center;">ZONING</p> <p>Zone: _____</p> <p>Access Approved: <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Flood Plan Approval Required <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p style="padding-left: 40px;"><input type="checkbox"/> Approved <input type="checkbox"/> Disapproved</p> <p>By: _____</p> <p>Date: _____</p>	<p style="text-align: center;">ENVIRONMENTAL HEALTH SERVICES DEPARTMENT</p> <p>E-Log Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Gravel Chute Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p style="text-align: center;"><u><i>[Signature]</i></u></p>

REASONS FOR DENIAL OR CONDITIONS OF PERMIT:

THIS APPLICATION BECOMES A PERMIT WHEN APPROVED

Kern County
Environmental Health Services Department
7700 "M" Street, Suite 300
Bakersfield, CA 93301
Phone (661) 862-8700
FAX (661) 862-8701

Parcel/Map/Tract _____

Parcel No. _____

Assessor's Parcel No. 99-290-03

LOCATION

- A. Indicate below the exact location of well with respect to the following items: property lines, water bodies or courses, drainage pattern, roads, existing wells, structures, sewers or private disposal systems. Include dimensions.

See attached map. CYM-17N1

- B. LOCATION OF WELL WITHIN SECTION LINES - Locate well by measuring from proposed site in relation to section lines or half section lines.

Section No.:

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

1- _____ One Mile _____ -1

Kern County
Environmental Health Services Department
2700 "M" Street, Suite 300
Bakersfield, CA 93301
Phone (661) 862-8700
FAX (661) 862-8701



Permit # EH-1401

CYM-2101

CYM-2101

APPLICATION FOR PERMIT TO
CONSTRUCTION, RECONSTRUCT, DEEPEN OR DESTROY A WELL

APPLICATION DATE: 10/29/02 PROPOSED START DATE 11/18/02
OWNER: Valley Waste Disposal Company Phone: 661.322.5004
Mailing Address: 1400 Easton Dr., 5139-B City Bakersfield Zip: 93309
DRILLING Contractor's
CONTRACTOR Water Development Corp License 283326 Phone: 530.662.2829
Address: P.O. Box 141 City: Zamora Zip: 95698
SUBCONTRACTOR: Geomega Inc Phone: 303.443.9117
Address: 2995 Baseline Road, 5202 City: Boulder, CO Zip: 80303
JOB SITE: T 29S R 22E Sec. 21 40 Acre Sub D
PROPERTY DESCRIPTION: Assessor's Parcel No.: 99-290-06
SITE ADDRESS if available: Near intersection of Hwy 33 & Lokern Rd TOTAL ACRES: < 1
DIRECTIONS to Well Site: 1/2 mile west of Safety Klean facility on South side of Lokern Road. See attached map.

TYPE OF WORK TO BE DONE: (check one)

☒ New Well

☐ Deepen

☐ Reconstruction

☐ Destruction

INTENDED USE:

- ☐ Domestic/private (1 connection)
☐ Domestic/nonpublic (2-4 connections)
☐ Domestic/public (5 or more conn.)
☐ Agricultural
☐ Test Hole
☒ Monitoring
☐ Cathodic Protection
☐ Other _____

CONSTRUCTION METHOD:

- ☐ Reverse Rotary
☐ Rotary
☒ Air Rotary
☒ Other mud rotary

SEALING MATERIAL (check one)

- ☐ Neat Cement
☒ Cement Grout
☐ Concrete
☐ Other _____

GRAVEL PACK: (check one)

- ☒ Yes ☐ No
From 185 To 245 Feet

PROPOSED WELL
CONSTRUCTION (DEPTH)

Max. 285 Feet
Min. _____ Feet

PROPOSED PERFORATIONS
OR SCREEN:

From 185 To 245 Feet
From _____ To _____ Feet

PROPOSED CASING:

Type PVC
Diameter 5"
Gauge/Wall SC 80
Conductor Depth 50

PROPOSED ANNULAR SEAL DEPTH:

Unconsolidated best pellets
Hardrock 175-185

PENETRATES TWO OR MORE
AQUIFERS

☐ Yes ☒ No

PROPOSED WELL DESTRUCTION SEAL DEPTH _____

DEPTH OF WELL TO BE DESTROYED _____

THIS APPLICATION BECOMES A PERMIT WHEN APPROVED

GENERAL CONDITIONS:

1. Permit applications will be submitted to the Planning Department for zoning, access, and flood plain clearances prior to approval of the Environmental Health Services Department. If you are drilling within city's limits, you will have to receive approval from their planning department.
2. Permit applications must be submitted to the Environmental Health Services Department at least ten working days prior to the proposed starting date.
3. Well site approval is required before beginning any work related to well construction. It is unlawful to continue work past the stage at which an inspection is required unless inspection is waived or completed.
4. Other required inspections include: setting conductor casing, E-Logs, all annular seals, and final construction features.
5. In areas where a well penetrates more than one aquifer, and one or more of the aquifers may contain water which is of a quality which may degrade the other aquifer(s) penetrated if allowed to commingle, an E-Log shall be required to determine the location of the confining clay layer(s) and assist in the placement of any required annular seal(s).
6. A phone call to the Department office is required on the morning of the day that work is to commence and 24 hours before the placement of any seals or plugs.
7. Approval of water quality and final construction features is required before the well is put into use.
8. Construction under this permit is subject to any instructions by Department representatives.
9. Any misrepresentation or noncompliance with required permit conditions, or regulations, will result in issuance of a "Stop Work Order."
10. A copy of the Department of Water Resources Driller's Report and water quality analyses must be submitted to the Environmental Health Services Department within 30 days after completion of the work.
11. "Dry" holes must be properly destroyed within two (2) weeks of drilling. A well destruction application must be filed with this Department.
12. The permit is void on the ninetieth (90th) calendar day after date of issuance if work has not been started and reasonable progress toward completion made. Fees are not refundable nor transferable.
13. Lead appurtenances shall not be used in construction of any private or public water supply system. The use of solders containing more than 2/10 of 1% lead is prohibited in making joints and fittings in any private or public potable water system.
14. Permittee shall assume entire responsibility for all activities and uses under this permit and shall indemnify, defend and save the County of Kern and/or Kern County Water Agency, its officers, agents, and employees, free and harmless from any and all expense, cost or liability in connection with or resulting from the exercise of this permit, including, but not limited to, property damage, personal injury, and wrongful death.

I certify that I am the owner of the above-described property, or the authorized representative of such owner, and that all the information I have furnished is current and accurate to the best of my knowledge, and I intend to construct/destroy the well as represented above. I understand that all work is to be done in accordance with Kern County Ordinance Code Chapter 14.08 and Bulletin 74-81 and the conditions of the Permit Application, including any conditions which may be added or changed by the Environmental Health Services Department upon review of this Application and issuance of the Permit. I further understand that any permit issued pursuant to this application is subject to such further conditions as may be deemed necessary to ensure compliance with the permit regulations.

Owner's Signature *[Signature]* Date 10/31/02 Authorized Agent _____ Date _____ or Agency _____

Internal use only Permit Approved: <u><i>[Signature]</i></u> Date: <u>11-1-02</u> Expiration Date: _____		Total Fee: <u>335</u> Date Paid: <u>11-1-02</u> Receipt # _____ <input type="checkbox"/> Cash <input checked="" type="checkbox"/> Check (# _____) Fee received by: <u><i>[Signature]</i></u>	
ZONING Zone: _____ Access Approved: <input type="checkbox"/> Yes <input type="checkbox"/> No Flood Plan Approval Required <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Approved <input type="checkbox"/> Disapproved By: _____ Date: _____		ENVIRONMENTAL HEALTH SERVICES DEPARTMENT E-Log Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Gravel Chute Required: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <div style="text-align: center;"><u><i>[Signature]</i></u></div>	

REASONS FOR DENIAL OR CONDITIONS OF PERMIT:

THIS APPLICATION BECOMES A PERMIT WHEN APPROVED

Kern County
Environmental Health Services Department
2700 "M" Street, Suite 300
Bakersfield, CA 93301
Phone (661) 862-8700
FAX (661) 862-8701

Parcel/Map/Tract _____

Parcel No. _____

Assessor's Parcel No. 99-290-06

LOCATION

- A. Indicate below the exact location of well with respect to the following items: property lines, water bodies or courses, drainage pattern, roads, existing wells, structures, sewers or private disposal systems. Include dimensions.

See attached map. CYM-2101

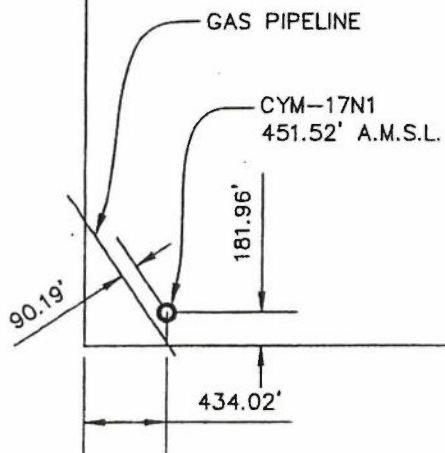
- B. LOCATION OF WELL WITHIN SECTION LINES - Locate well by measuring from proposed site in relation to section lines or half section lines.

Section No.:

¹⁷⁰⁰ _{300'} D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

1- _____ One Mile _____ -1

SECTION 17
29/22



1" = 1000'

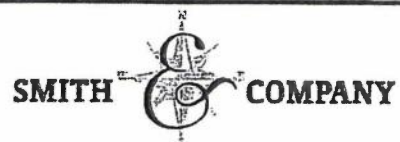
434.02' EAST ALONG THE SOUTH LINE, THENCE 181.96' NORTH AT
90° FROM THE SOUTHWEST CORNER OF SECTION 17, T. 29 S.,
R. 22 E., M.D.B.&M.
ELEVATION = 451.52'

PREPARED FOR:

VALLEY WASTE

DESCRIPTION:

PRELIMINARY WELL LOCATION



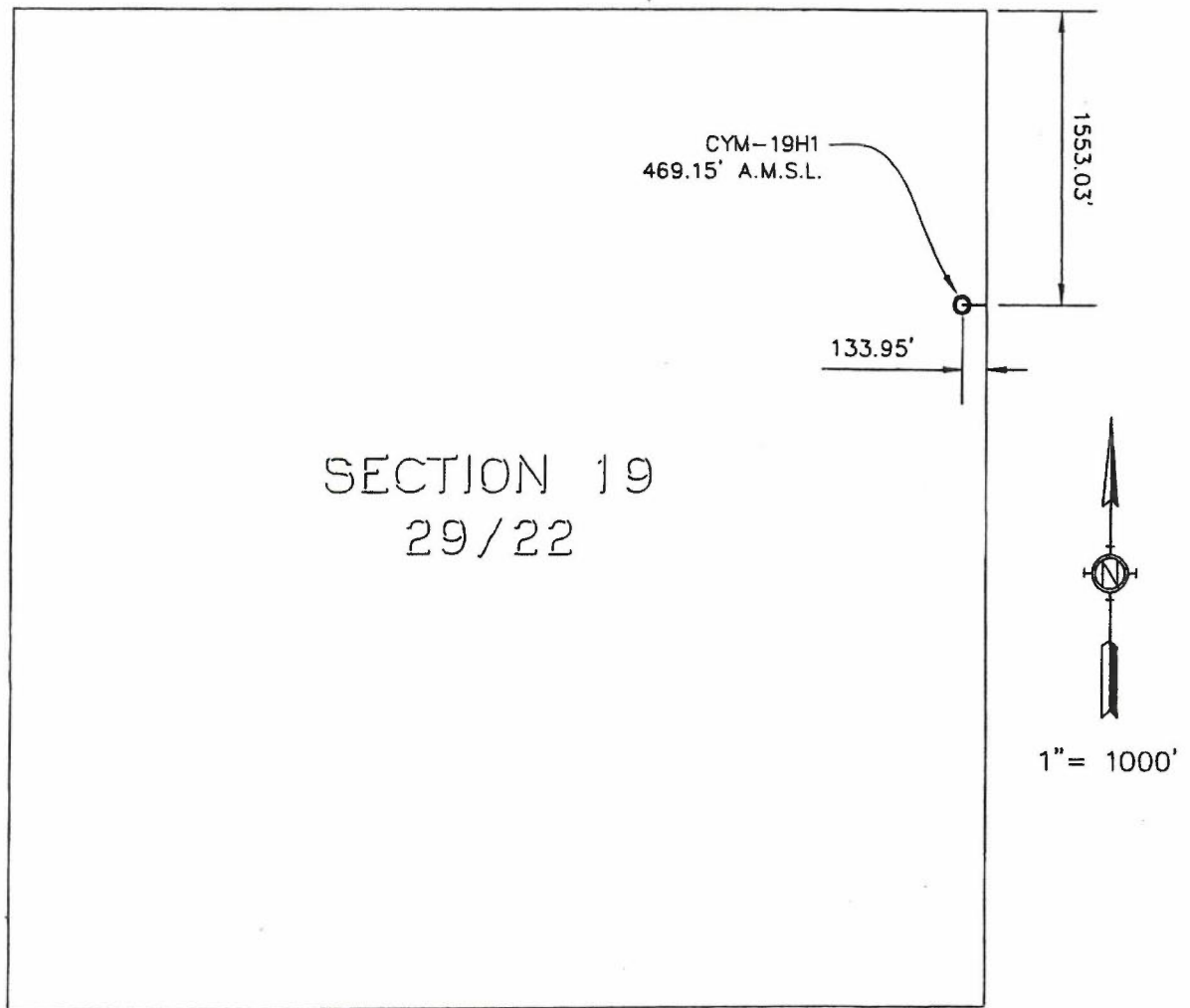
P.O. BOX 81626
BAKERSFIELD, CA 93380

PHONE: (661) 393-1217
FAX: (661) 393-1218

DATE: 1/14/03

DRAWN BY: RGS

JOB NO.: 16-178



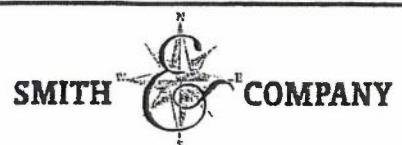
1553.03' SOUTH ALONG THE EAST LINE, THENCE 133.95' WEST AT
90° FROM THE NORTHEAST CORNER OF SECTION 19, T. 29 S.,
R. 22 E., M.D.B. & M.
ELEVATION = 469.15'

PREPARED FOR:

VALLEY WASTE

DESCRIPTION:

FINAL WELL LOCATION



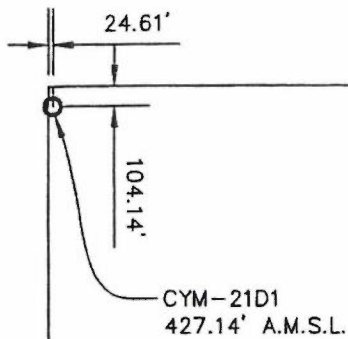
P.O. BOX 81626
BAKERSFIELD, CA 93380

PHONE: (661) 393-1217
FAX: (661) 393-1218

DATE: 1/14/03

DRAWN BY: RGS

JOB NO.: 16-178



SECTION 21 29/22



1" = 1000'

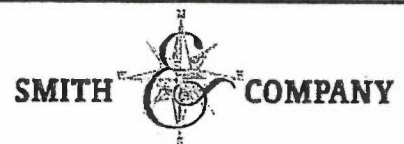
24.61' EAST ALONG THE NORTH LINE, THENCE 104.14' SOUTH AT
90° FROM THE NORTHWEST CORNER OF SECTION 21, T. 29 S.,
R. 22 E., M.D.B.&M.
ELEVATION = 427.14'

PREPARED FOR:

VALLEY WASTE

DESCRIPTION:

FINAL WELL LOCATION



P.O. BOX 81626
BAKERSFIELD, CA 93380

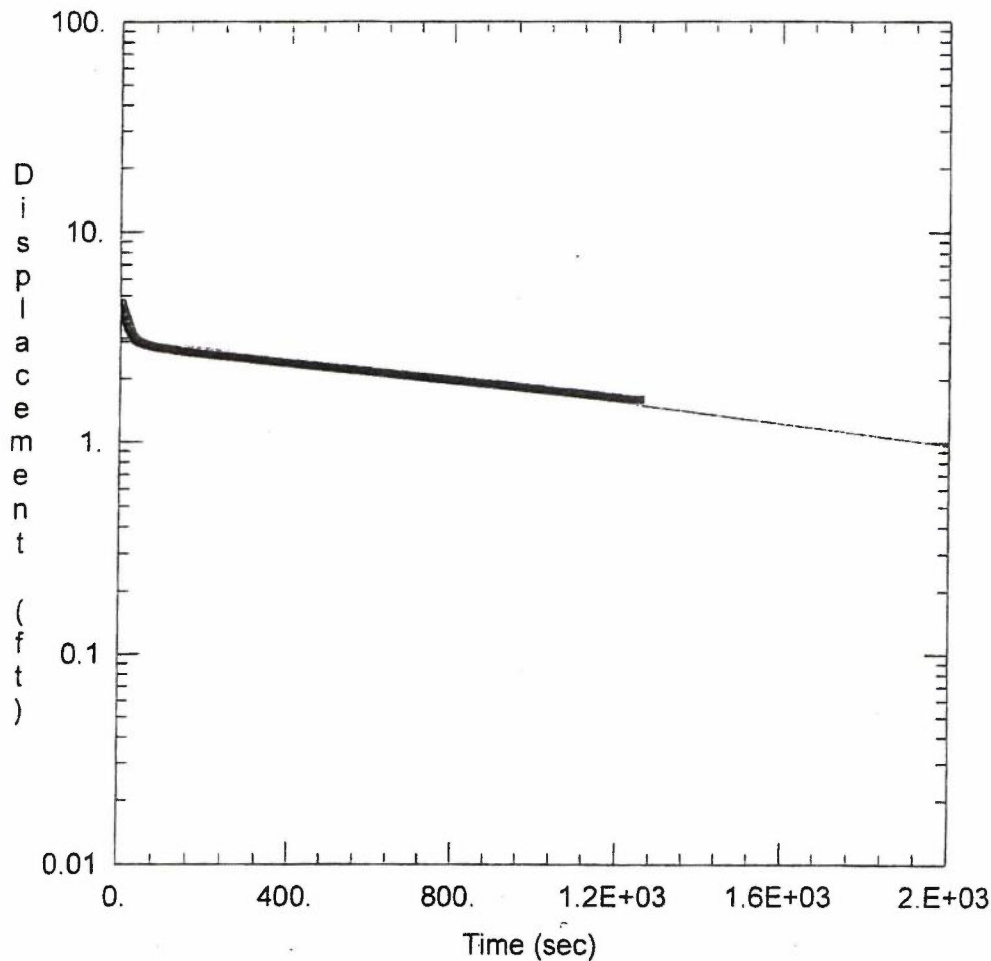
PHONE: (661) 393-1217
FAX: (661) 393-1218

DATE: 1/14/03

DRAWN BY: RGS

JOB NO.: 16-178

Appen div D



UNCONFINED SLUG TEST

Data Set: P:\VWD\CYMRIC\SLUGTE~1\SLUG_C~1\17N1A.AQT
 Date: 06/17/03 Time: 11:46:45

PROJECT INFORMATION

Company: VWDC
 Client: Larry Bright
 Test Location: Cymric Field
 Test Well: CYM-17N1
 Test Date: 11/02

AQUIFER DATA

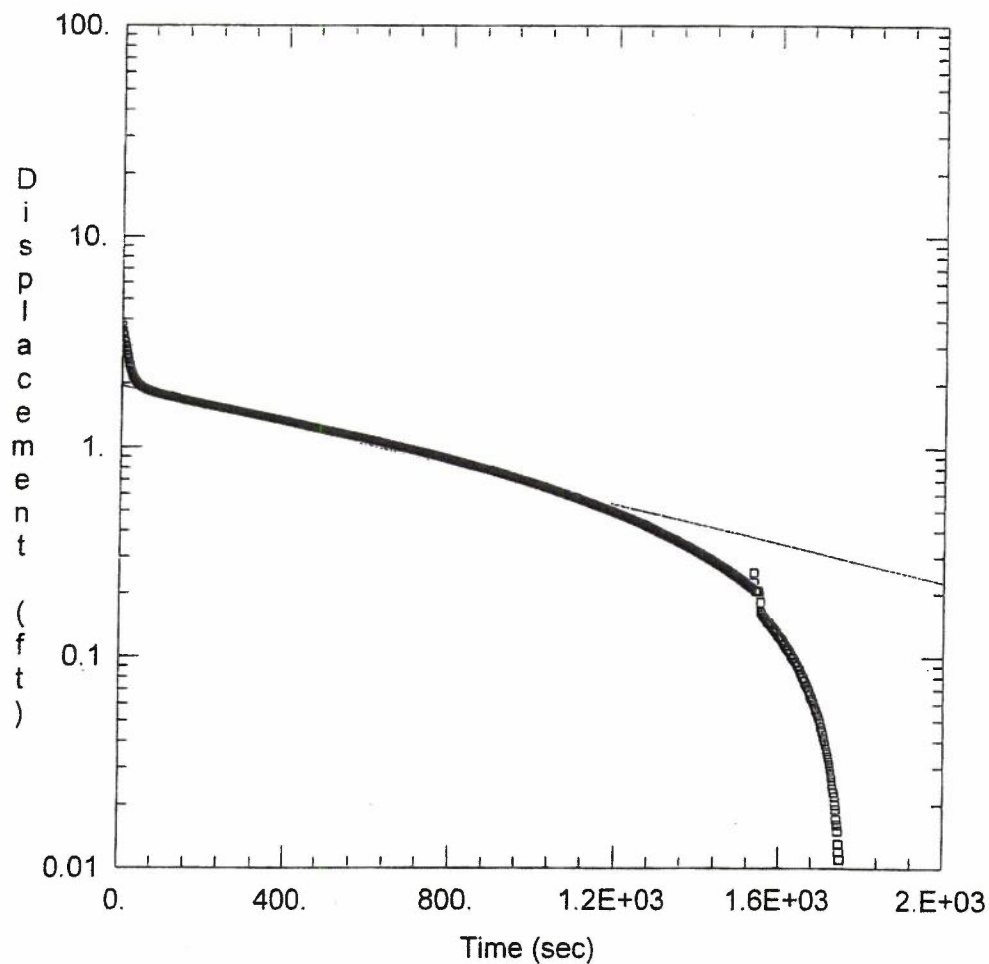
Saturated Thickness: 38 ft Anisotropy Ratio (K_z/K_r): 1

WELL DATA

Initial Displacement: 4.637 ft Water Column Height: 35 ft
 Casing Radius: 0.2083 ft Wellbore Radius: 0.4375 ft
 Screen Length: 25 ft Gravel Pack Porosity: 0.45

SOLUTION

Aquifer Model: Unconfined $K = 3.952E-06$ ft/sec ($1.20E-04$ cm/sec)
 Solution Method: Bouwer-Rice $y_0 = 3.129$ ft



UNCONFINED SLUG TEST

Data Set: P:\VWD\CYMRIC\SLUGTE~1\SLUG C~1\17N1B.AQT

Date: 06/17/03

Time: 11:48:43

PROJECT INFORMATION

Company: VWDC

Client: Larry Bright

Project: C01232A

Test Location: Cymric Field

Test Well: CYM-17N1

Test Date: 11/02 Test 2

AQUIFER DATA

Saturated Thickness: 38 ft

Anisotropy Ratio (K_z/K_r): 1

WELL DATA

Initial Displacement: 3.697 ft

Water Column Height: 35 ft

Casing Radius: 0.2083 ft

Wellbore Radius: 0.4375 ft

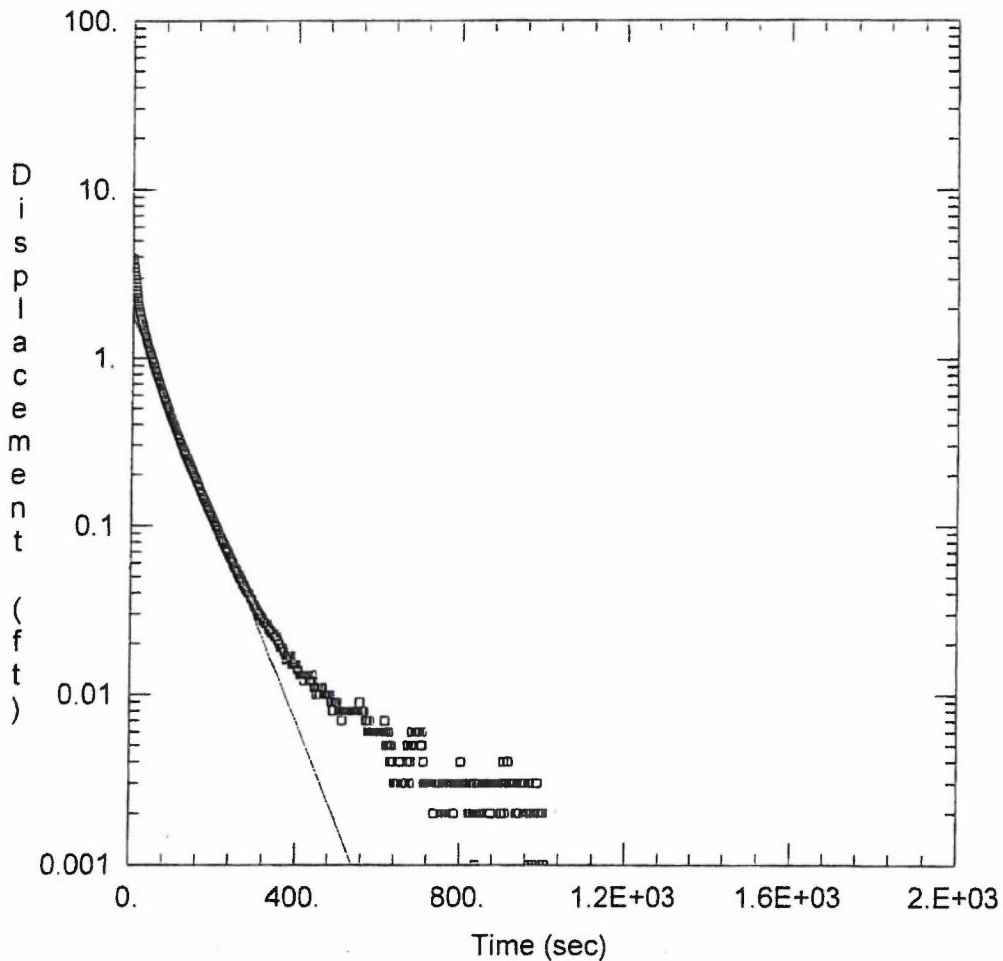
Screen Length: 25 ft

Gravel Pack Porosity: 0.45

SOLUTION

Aquifer Model: Unconfined

$K = 7.241E-06$ ft/sec ($2.21E-04$ cm/sec)



UNCONFINED SLUG TEST

Data Set: P:\VWD\CYMRIC\SLUGTE~1\SLUG_C~1\19H1A.AQT

Date: 06/17/03

Time: 11:36:23

PROJECT INFORMATION

Company: VWDC

Client: Larry Bright

Project: C01232A

Test Location: Cymric Field

Test Well: CYM-19H1

Test Date: 11/02

AQUIFER DATA

Saturated Thickness: 42. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 3.935 ft

Water Column Height: 36. ft

Casing Radius: 0.2083 ft

Wellbore Radius: 0.4375 ft

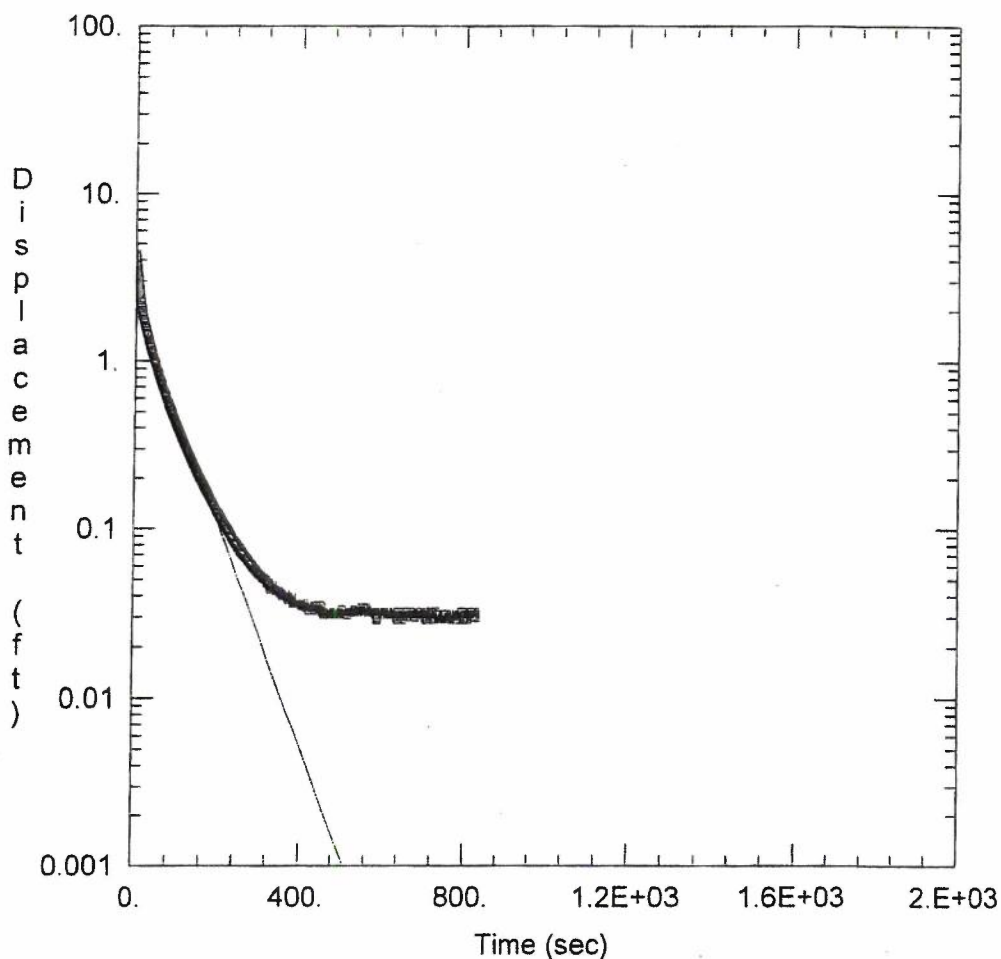
Screen Length: 25. ft

Gravel Pack Porosity: 0.45

SOLUTION

Aquifer Model: Unconfined

$K = 9.196E-05$ ft/sec / 2.80E-03 cm/sec



UNCONFINED SLUG TEST

Data Set: P:\VWD\CYMRIC\SLUGTE~1\SLUG C~1\19H1B.AQT

Date: 06/17/03

Time: 11:55:34

PROJECT INFORMATION

Company: VWDC

Client: Larry Bright

Project: C01232A

Test Location: Cymric Field

Test Well: CYM-19H1

Test Date: 11/02 Test 2

AQUIFER DATA

Saturated Thickness: 42. ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA

Initial Displacement: 4.295 ft

Water Column Height: 36. ft

Casing Radius: 0.2083 ft

Wellbore Radius: 0.4375 ft

Screen Length: 25. ft

Gravel Pack Porosity: 0.45

SOLUTION

Aquifer Model: Unconfined

$K = 0.0001001 \text{ ft/sec}$ ($3.05E-03 \text{ cm/sec}$)

Solution Method: Bouwer Rice

Appendix E



Historical Data Map Interface

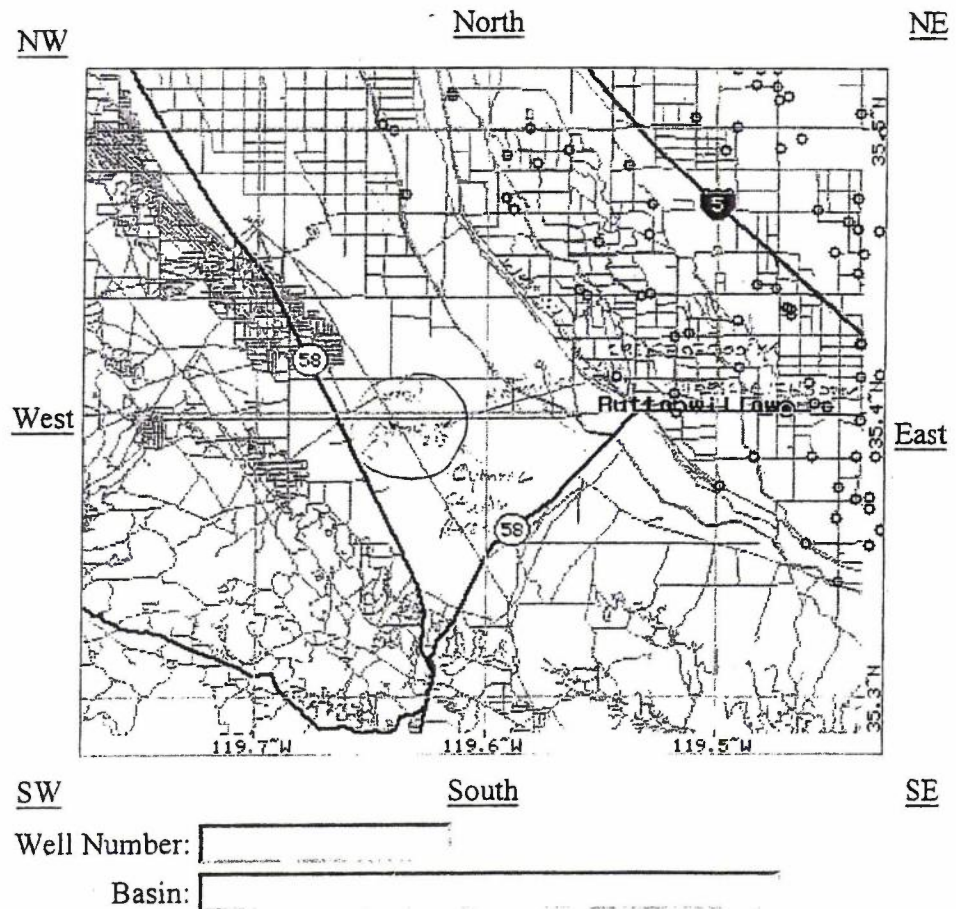
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Instructions (Step 4 of 4)

[WDL Home](#)

- [Water Quality](#)
- [Groundwater](#)

This map provides access to individual water well data. Click on one of the red symbols on the map below to retrieve a hydrograph and tabular listing of the data for that well. If no symbols appear on the map, then no water level data are available for that area. Data may also be obtained using our [text interface](#).

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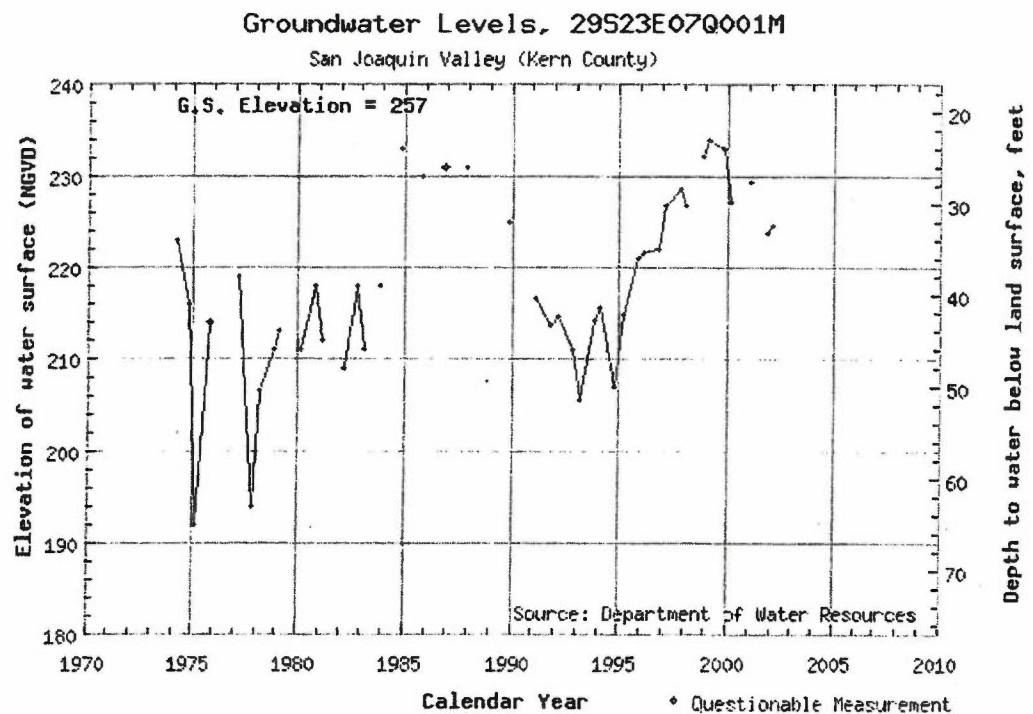
Query Results for 29S23E07Q001M

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- [Water Quality](#)
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Your selection returned a total of 55 records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the *New Search* or *Nearby Search* buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Groundwater Level Readings

Meas. Date	P.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QMC	NMC	Agency
02-04-1974	258.0	257.0	35.0	223.0	34.0			5133
09-27-1974	258.0	257.0	42.0	216.0	41.0			5133
01-31-1975	258.0	257.0	66.0	192.0	65.0			5133
09-26-1975	258.0	257.0	44.0	214.0	43.0	6		5133
10-08-1976	258.0	257.0					3	5133
02-07-1977	258.0	257.0	39.0	219.0	38.0			5133
10-11-1977	258.0	257.0	64.0	194.0	63.0			5133
02-22-1978	258.0	257.0	51.5	206.5	50.5			5133
10-11-1978	258.0	257.0	47.0	211.0	46.0			5133
01-24-1979	258.0	257.0	45.0	213.0	44.0			5133
10-03-1979	258.0	257.0					3	5133
01-31-1980	258.0	257.0	47.0	211.0	46.0			5133
09-25-1980	258.0	257.0	40.0	218.0	39.0			5133
02-19-1981	258.0	257.0	46.0	212.0	45.0			5133
09-30-1981	258.0	257.0					1	5001

02-01-1982	258.0	257.0	49.0	209.0	48.0		5001
10-06-1982	258.0	257.0	40.0	218.0	39.0		5133
01-31-1983	258.0	257.0	47.0	211.0	46.0		5133
10-18-1983	258.0	257.0	40.0	218.0	39.0		5001
02-02-1984	258.0	257.0				5	5001
10-12-1984	258.0	257.0	25.0	233.0	24.0		5001
02-05-1985	258.0	257.0				9	5001
10-14-1985	258.0	257.0	28.0	230.0	27.0		5001
02-08-1986	258.0	257.0				9	5001
10-21-1986	258.0	257.0	27.0	231.0	26.0	8	5001
02-10-1987	258.0	257.0				9	5133
11-06-1987	258.0	257.0	27.0	231.0	26.0		5133
02-10-1988	258.0	257.0				3	5133
10-07-1988	258.0	257.0				3	5133
02-13-1989	258.0	257.0				9	5133
10-05-1989	258.0	257.0	33.0	225.0	32.0		5133
01-26-1990	258.0	257.0					5133
10-08-1990	258.0	257.0				7	5133
01-28-1991	258.0	257.0	41.4	216.6	40.4		5133
10-04-1991	258.0	257.0	44.5	213.5	43.5		5133
02-03-1992	258.0	257.0	43.4	214.6	42.4		5133
10-20-1992	258.0	257.0	47.2	210.8	46.2		5133
02-10-1993	258.0	257.0	52.5	205.5	51.5		5133
10-11-1993	258.0	257.0	43.8	214.2	42.8		5133
01-27-1994	258.0	257.0	42.5	215.5	41.5		5133
09-28-1994	258.0	257.0	51.0	207.0	50.0		5133
03-01-1995	258.0	257.0	43.3	214.7	42.3		5133
10-16-1995	258.0	257.0	37.0	221.0	36.0		5133
01-18-1996	258.0	257.0	36.4	221.6	35.4		5133
10-01-1996	258.0	257.0	36.1	221.9	35.1		5133
01-29-1997	258.0	257.0	31.3	226.7	30.3		5121
10-09-1997	258.0	257.0	29.5	228.5	28.5		5121
01-30-1998	258.0	257.0	31.3	226.7	30.3		5133
10-23-1998	258.0	257.0	25.9	232.1	24.9		5133
01-22-1999	258.0	257.0	24.0	234.0	23.0		5133
10-08-1999	258.0	257.0	25.1	232.9	24.1		5133
01-18-2000	258.0	257.0	30.9	227.1	29.9		5133
01-11-2001	258.0	257.0	28.7	229.3	27.7		5133
10-05-2001	258.0	257.0	34.3	223.7	33.3		5133
01-16-2002	258.0	257.0	33.6	224.4	32.6		5133

Well Coordinate Information

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	269107	3921561	metres	11
LL	NAD27	119.5428	35.4125	decimal degrees	

For more information contact:

Department of Water Resources, San Joaquin District
 Water Management Section
 3374 East Shields Avenue
 Fresno, CA 93726

Phone: 559-230-3326

Fax: 559-230-3301

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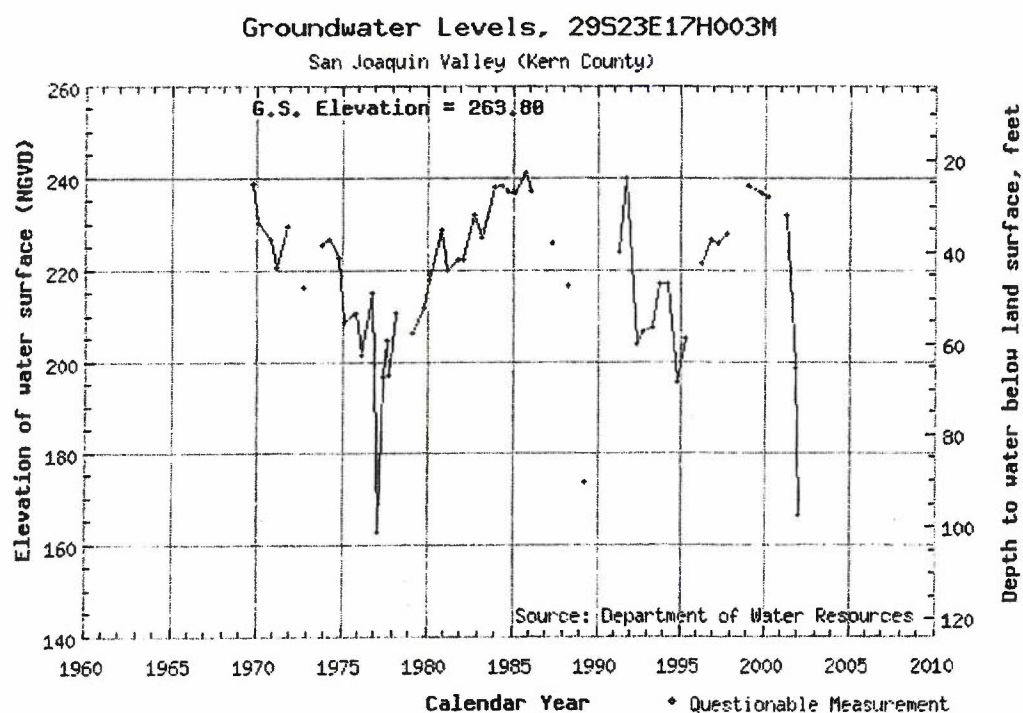
Query Results for 29S23E17H003M

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Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	R/SB	GSWS	QMC	NMC	Agency
10-02-1969	264.8	263.8	26.4	238.4	25.4			5640
02-02-1970	264.8	263.8	34.7	230.1	33.7			5640
10-02-1970	264.8	263.8	38.4	226.4	37.4			5640
02-01-1971	264.8	263.8	44.1	220.7	43.1			5640
10-01-1971	264.8	263.8	35.4	229.4	34.4			5640
03-01-1972	264.8	263.8					1	5640
10-04-1972	264.8	263.8	48.6	216.2	47.6			5640
03-01-1973	264.8	263.8					1	5640
10-01-1973	264.8	263.8	39.4	225.4	38.4			5640
03-01-1974	264.8	263.8	38.1	226.7	37.1			5640
10-01-1974	264.8	263.8	42.1	222.7	41.1			5640
02-01-1975	264.8	263.8	56.1	208.7	55.1			5640
10-01-1975	264.8	263.8	54.3	210.5	53.3			5640
02-01-1976	264.8	263.8	63.2	201.6	62.2			5640
10-04-1976	264.8	263.8	50.0	214.8	49.0			5640

02-01-1977	264.8	263.8	102.1	162.7	101.1		5640
06-02-1977	264.8	263.8	68.2	196.6	67.2		5640
08-01-1977	264.8	263.8	60.3	204.5	59.3		5640
10-03-1977	264.8	263.8	68.0	196.8	67.0		5640
02-02-1978	264.8	263.8	54.2	210.6	53.2		5640
02-02-1979	264.8	263.8	58.6	206.2	57.6		5640
10-01-1979	264.8	263.8	53.0	211.8	52.0		5640
02-04-1980	264.8	263.8	47.1	217.7	46.1		5640
10-01-1980	264.8	263.8	36.2	228.6	35.2		5640
02-02-1981	264.8	263.8	44.9	219.9	43.9		5640
10-01-1981	264.8	263.8	42.5	222.3	41.5		5001
02-02-1982	264.8	263.8	42.5	222.3	41.5		5001
10-04-1982	264.8	263.8	33.1	231.7	32.1		5640
03-10-1983	264.8	263.8	37.9	226.9	36.9		5640
11-01-1983	264.8	263.8	26.8	238.0	25.8		5001
04-09-1984	264.8	263.8	26.6	238.2	25.6		5001
09-01-1984	264.8	263.8	27.6	237.2	26.6		5001
01-15-1985	264.8	263.8	28.2	236.6	27.2		5001
09-12-1985	264.8	263.8	24.0	240.8	23.0		5001
01-02-1986	264.8	263.8	27.8	237.0	26.8		5001
04-15-1987	264.8	263.8	39.0	225.8	38.0		5640
10-07-1987	264.8	263.8				9	5640
04-04-1988	264.8	263.8	48.2	216.6	47.2		5640
10-01-1988	264.8	263.8				7	5640
03-21-1989	264.8	263.8	91.2	173.6	90.2		5640
10-10-1989	264.8	263.8				7	5640
05-11-1990	264.8	263.8				7	5640
03-12-1991	264.8	263.8	41.1	223.7	40.1		5640
09-09-1991	264.8	263.8	25.0	239.8	24.0		5640
03-26-1992	264.8	263.8	61.1	203.7	60.1		5640
09-22-1992	264.8	263.8	58.3	206.5	57.3		5640
03-24-1993	264.8	263.8	57.2	207.6	56.2		5640
09-21-1993	264.8	263.8	47.6	217.2	46.6		5640
03-07-1994	264.8	263.8	48.0	216.8	47.0		5640
09-28-1994	264.8	263.8	69.2	195.6	68.2		5640
03-29-1995	264.8	263.8	60.0	204.8	59.0		5640
10-02-1995	264.8	263.8				7	5640
03-13-1996	264.8	263.8	43.4	221.4	42.4		5640
09-24-1996	264.8	263.8	38.1	226.7	37.1		5640
03-20-1997	264.8	263.8	38.9	225.9	37.9		5640
09-23-1997	264.8	263.8	37.0	227.8	36.0		5640
01-02-1999	264.8	263.8	26.7	238.1	25.7		5640
10-01-1999	264.8	263.8	28.2	236.6	27.2		5640
03-01-2000	264.8	263.8	29.1	235.7	28.1		5640
03-21-2001	264.8	263.8	32.8	232.0	31.8		5640
10-01-2001	264.8	263.8	66.1	198.7	65.1		5640
01-01-2002	264.8	263.8	98.4	166.4	97.4		5640
09-23-2002	264.8	263.8				S	5640

Well Coordinate Information

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	271360	3920794	metres	11

LL NAD27 119.5178 35.4061 decimal degrees

For more information contact:

*Department of Water Resources, San Joaquin District
Water Management Section
3374 East Shields Avenue
Fresno, CA 93726*

Phone: 559-230-3326

Fax: 559-230-3301

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Appendix F

APPENDIX F

DESCRIPTION OF ISOTOPES AS GEOCHEMICAL TRACERS OF WATER

Isotope Occurrence and Abundance of Oxygen/Hydrogen (O/H) Stable Isotopes

Isotopes are atoms of the same element which have different numbers of neutrons; they have the same chemical behavior and the same number of protons, but slightly different weights and, sometimes, different radioactive properties. The superscript of an element when written in chemical notation represents the total number of protons and neutrons in that element and distinguishes one isotope of the same element from another. Naturally occurring uranium (U), for example, is primarily composed of ^{235}U (< 1 percent) and ^{238}U (> 99 percent); although 14 different isotopes of U are known. Most naturally occurring isotopes are not radioactive, however, and many elements in the periodic table are each composed of several stable isotopes. Calcium is composed of six stable isotopes, titanium of five, iron of four, and so on. The percentage abundance of each stable isotope in any element is constant. However, in lighter elements there are small variations in stable isotope abundances.

Water is composed of O and H, each of which has several stable isotopes. Oxygen is composed of three isotopes with the following abundances: ^{16}O = 99.756 percent, ^{17}O = 0.039 percent, and ^{18}O = 0.205 percent. Hydrogen is composed of two stable isotopes with the following abundances: ^1H = 99.985 percent and ^2H or D (for Deuterium) = 0.015 percent (Faure, 1991). Tritium, ^3H does not occur naturally and is only formed in areas with an abundance of radioactive minerals (U^{235}) or near radioactive, hazardous waste sites.

Isotopic Chemical Behavior – Fractionation and Exchange

Among the heavier and metallic elements, the relative weight difference between isotopes of the same element has no effect on their behavior. Among the lighter elements, however, the relative weight difference between the separate stable isotopes is large enough that they behave slightly different in a variety of chemical reactions. Hydrogen best illustrates this difference: D weighs twice as much as ^1H . The study of light isotopes has particular significance in the biosphere and the atmosphere where isotopes of H, carbon, nitrogen, and O are preferentially selected under different conditions in numerous chemical and physical reactions: photosynthesis, evaporation, condensation, crystallization, and fermentation.

There are several ways in which the relative abundances of H and O isotopes in water may be altered. Most water is composed of H_2^{16}O , which is the lightest of the isotope combinations, but small percentages contain either D, ^{17}O or ^{18}O . The heavy isotope waters HD^{16}O , H_2^{17}O , and H_2^{18}O are each slightly heavier (6 percent, 6 percent, or 11 percent respectively) than normal

H_2^{16}O . Due to this mass difference, heavy isotope waters require more energy to evaporate from liquid and less energy to condense from vapor (Gat, 1981). Thus, as water evaporates, the liquid phase will enrich in the heavier isotopes over time. The vapor phase, however, will be depleted in the heavier isotopes in comparison to the liquid from which it evaporated. Similarly, liquid, which condenses from vapor, will be enriched in the heavier isotopes, while the remaining vapor becomes depleted in heavy isotopes. This process of enrichment and depletion of naturally occurring, stable isotopes in water by evaporation/condensation is called fractionation.

Another process by which water becomes enriched in ^{18}O is by chemical exchanges of O with terrigenous materials enriched in ^{18}O . This occurs most commonly with rocks, because all rocks are found to be enriched in ^{18}O to some extent. Under heated conditions, water will react with rocks by either dissolution or formation of new hydrated minerals. In either case, O will be exchanged between the liquid and solid rock, usually via the hydroxyl ion (OH^-). Even when rocks and water coexist stably under heat, exchange will occur due to constant minor fluctuations in equilibrium. Thus, whenever water interacts chemically with rock, O is exchanged between the two, and the relative abundance of ^{18}O will increase in the water.

Standard Measurement of Oxygen (O) and Hydrogen (H) Isotopes

The standardized measurement of O and H isotopes was derived by Craig (1961a). In any sample, the isotopes are measured as the difference between the isotope ratios ($^{18}\text{O}/^{16}\text{O}$ and D/H) of the sample to Standard Mean Ocean Water (SMOW). SMOW is a mixture of seawaters from the Indian, Pacific, and Atlantic oceans at the equator and is an arbitrary standard. The differences between the isotope ratios of most samples and SMOW is quite small, and so is measured in parts per thousand, or a per millage (o/oo) instead of a percentage (%). The standard notation for isotopic measurements is a lower case (δ).

Thus, for $\delta^{18}\text{O}$:

$$\delta^{18}\text{O} \text{ (o/oo)} = \frac{(^{18}\text{O}/^{16}\text{O})_{\text{SMOW}} - (^{18}\text{O}/^{16}\text{O})_{\text{Sample}}}{(^{18}\text{O}/^{16}\text{O})_{\text{SMOW}}} \times 1000$$

And similarly, for δD :

$$\delta\text{D} \text{ (o/oo)} = \frac{(\text{D}/\text{H})_{\text{SMOW}} - (\text{D}/\text{H})_{\text{Sample}}}{(\text{D}/\text{H})_{\text{SMOW}}} \times 1000$$

Measurements of ^{17}O abundances are not performed regularly because this isotope experiences the same isotope-specific reactions as ^{18}O but is one-fifth as abundant, and therefore, less suitable

for measurement.

Measurement accuracy by current lab methods is ± 0.1 for $\delta^{18}\text{O}$, and ± 1 for δD . Most naturally occurring waters have isotope values which range from +2 to -22 for $\delta^{18}\text{O}$, and +20 to -16 for δD . Rocks also display a regular pattern of ^{18}O abundance, which increases from mafic to basic igneous rocks, to metamorphic rocks, to siliciclastic then carbonate sedimentary rocks, to organically precipitated rocks of silica and calcite.

Distribution of Oxygen (O) and Hydrogen (H) Isotopes in the Hydrosphere

As stated previously, liquid that forms from water vapor is depleted in the heavy isotopes of O and H: the resulting $\delta^{18}\text{O}$ and δD values are greater in the liquid than the vapor. One corresponding effect of condensation fractionalism is a global pattern in the isotopic abundances of precipitation. Most clouds on Earth form from evaporated ocean water at the equator, which then moves north and south to condense into clouds. As rain falls from these clouds, they progressively become depleted in the heavier isotopes. Moving from the equator to either pole, the average $\delta^{18}\text{O}$ and δD values in rain and snow decrease at a steady rate as more water precipitates from the clouds. This linear distribution of isotopes in meteoric water was found by Craig (1961b) and is termed the Meteoric Water Line or MWL, and defined as $\delta\text{D} = 8 \cdot \delta^{18}\text{O} + 10$. Consequently, all meteoric waters have a characteristic isotopic signature indicative of their place of origin: latitude, geography, and average temperature.

Weather patterns are quite regular, and correspondingly, δ values of meteoric waters display distinct regional patterns and have been mapped both globally and in detail over most of North America. Furthermore, the source of virtually all water encountered in the environment, especially surface and usable ground water, is meteoric water. Therefore, the δ values in groundwater aquifers will be similar to the values of regional meteoric waters that fill the aquifers. The δ values in groundwater are usually less variable because the residence time of water in the subsurface is longer.

Groundwater may be enriched in ^{18}O or D by evaporation or rock-water exchange in areas of geothermal activity. Due to high subsurface temperatures in geothermal areas, chemical reactions and exchanges between groundwater and rocks may occur. Oxygen can exchange between the rocks and the groundwater, causing the latter to enrich in ^{18}O . As shown on a $\delta^{18}\text{O}$ versus δD chart, this causes groundwater to move off the MWL line, laterally increasing along the $\delta^{18}\text{O}$ axis. Enrichment of ^{18}O and D can also occur by extensive subsurface evaporation or boiling of groundwater caused by geothermal heat. In either case, the $\delta^{18}\text{O}$ of groundwater increases, and falls off of the MWL, marking it as distinct from meteoric water.

Environmental Tracing of Water Using Stable Oxygen (O) and Hydrogen (H) Isotopes

Tracing the migration of water within an aquifer is possible using $\delta^{18}\text{O}$ and δD values if two or

Geomega

more isotopically distinct waters occur within the aquifer. Both mixing between two separate waters, or modeling of migration paths of one water within another are possible based on isotope concentration analysis. Mixing calculations utilizing δ values of ^{18}O and D are simple because they may be added arithmetically. For example, if a 3.5 liter pool of water ($\delta^{18}\text{O} = -9.0$) is mixed with a 6.5 liter pool of water ($\delta^{18}\text{O} = -1.0$), the resulting 10 liters of water will have a $\delta^{18}\text{O}$ of:

$$\frac{(3.5 \text{ L}) * (-9.0 \delta^{18}\text{O}) + (6.5 \text{ L}) * (-1.0 \delta^{18}\text{O})}{10.0 \text{ L}} = -3.8 \delta^{18}\text{O}$$

Possible environmental applications of the isotopes in water include: the modeling of migration in the subsurface of two different native groundwaters (Davisson and Criss, 1992), modeling and mixing estimation of water injected into an aquifer (Muir and Coplen, 1981), and regional source identification of waters in large aquifer areas (Davis and Coplen, 1989).

References

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- Craig, H. 1961b. Isotopic Variations in Meteoric Waters. Science, pages 1702-1703.
- Davisson, M.L., R.E. and Criss. 1992. Stable Isotope Imaging of A Dynamic Groundwater System in the Southwestern Sacramento Valley, California (USA). Submitted for publication in Journal of Hydrology.
- Faure, Gunter. 1991. Principles and Applications of Inorganic Geochemistry. Macmillan Publishing Company, New York, New York, 334 p.
- Gat, J.R. 1981. *Isotopic Fractionation in Isotope Hydrology*, International Atomic Energy Agency Technical Report, Serial No. 210, pp.21-34.
- Muir, K.S. and Tyler B. Coplen. 1981. Tracing Groundwater Movement by Using the Stable Isotopes of O and H, Upper Penitencia Creek Alluvial Fan, Santa Clara Valley, California. U.S. Geological Survey Water-Supply Paper 2075.

Appendix G

Cover Report

Geomega Inc.
2995 Baseline Rd. Suite 202
Boulder, CO 80303
Attn: Jeff Anderson

Project Number:
COC Number:
BCL Number: 02-12015

Dear Mr. Anderson:

This report contains the analytical results for the samples received under chain of custody by BC Laboratories, Inc. The samples were logged into the Laboratory Information Management System (LIMS) and BC Lab numbers were assigned to each sample. The result of the temperature check, condition of the samples and any other discrepancies were recorded on the cooler receipt form.

All applicable quality control procedures met method-specific acceptance criteria, except as noted on the following analytical and quality control reports.

This report shall not be reproduced except in full, without written approval of the laboratory.

California DOHS Certification #1186



Authorized Signature



Geomega Inc.

2995 Baseline Rd. Suite 202

Boulder, CO 80303

Attn: Jeff Anderson

Water Analysis (General Chemistry)

COC Number	---	Receive Date/Time										11/26/2002 @ 08:20		
Project Number	---	Sampling Date/Time										11/24/2002 @ 11:00		
Sampling Location	VWD,CYMRIC	Sample Depth										---		
Sampling Point	CYM-21D1	Sample Matrix										Groundwater		
Sampled By	P.VANMIDDLESWORTH	BCL Sample ID										02-12015-1		
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Calcium	100	mg/L	0.05	0.009	EPA-6010	12/03/02	12/05/02	20:05	ARD	TJA36E	1	253-105713	ND	
Magnesium	88	mg/L	0.05	0.04	EPA-6010	12/03/02	12/05/02	20:05	ARD	TJA36E	1	253-105713	ND	
Sodium	170	mg/L	0.5	0.2	EPA-6010	12/03/02	12/05/02	20:05	ARD	TJA36E	1	253-105713	ND	
Potassium	2.1	mg/L	1	0.3	EPA-6010	12/03/02	12/05/02	20:05	ARD	TJA36E	1	253-105713	ND	
Total Cations	20.1	meq/L	0.055	0.0078	Calculated						1			
Hydroxide	< PQL	mg/L	0.81	0.81	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	1	283-100816	ND	
Carbonate	< PQL	mg/L	1.5	1.5	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	1	283-100816	ND	
Bicarbonate	140	mg/L	2.9	2.9	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	1	283-100816	ND	
Sulfate	423	mg/L	2	0.16	EPA-300.0	11/26/02	11/26/02	10:27	DPC	IC1	2	268-101875	ND	A01
Chloride	334	mg/L	1	0.066	EPA-300.0	11/26/02	11/26/02	10:27	DPC	IC1	2	268-101875	ND	A01
Nitrate as N	0.85	mg/L	0.2	0.022	EPA-300.0	11/26/02	11/26/02	10:27	DPC	IC1	2	268-101875	ND	A01
Nitrate as NO3	3.8	mg/L	0.1	0.05	Calculated									
Total Anions	20.6	meq/L	0.1	0.1	Calculated									
pH	8.03	pH Units	0.05	0.05	EPA-9040	11/26/02	11/26/02	10:30	JSM	B360	1	257-101230		
Electrical Conductivity @ 25 C	1970	umhos/cm	1	1	EPA-9050	11/26/02	11/26/02	10:30	JSM	CND-3	1	196-101173		
TDS (by summation)	1200	mg/L	10		Calculated									
Hardness as CaCO3	624	mg/L	0.5	0.10	SM-2340B						1			
Sodium Adsorption Ratio (SAR)	3.0	-	0.01		Calculated									
Adjusted Sodium Adsorption Ratio (SAR-adj)	6.7	-	0.01		Calculated									



Water Analysis (General Chemistry)

Sample Description		VWD,CYMRIC, CYM-21D1, 11/24/2002 @ 11:00, P.VANMIDDLESWORTH												
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Extractable Sodium Percentage (ESP)	3.1	-	0.01		Calculated									
pHc	7.2	-	0.01		Calculated									
Gypsum Requirement	< PQL	#100% gyp./hr/100 gal./min.	0.01		Calculated									

Flag	Explanations
A01	PQL's and MDL's are raised due to sample dilution.

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02-12015-1



Laboratories, Inc

Geomega Inc.

2995 Baseline Rd. Suite 202

Boulder, CO 80303

Attn: Jeff Anderson

Water Analysis (General Chemistry)

COC Number	---								Receive Date/Time		11/26/2002 @ 08:20				
Project Number	---								Sampling Date/Time		11/25/2002 @ 11:30				
Sampling Location	VWD,CYMRIC								Sample Depth		---				
Sampling Point	CYM-17N1								Sample Matrix		Groundwater				
Sampled By	P.VANMIDDLESWORTH								BCL Sample ID		02-12015-2				
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab. Quals	
Calcium	810	mg/L	0.25	0.05	EPA-6010	12/03/02	12/05/02	20:09	ARD	TJA36E	5	253-105713	ND	A01	
Magnesium	330	mg/L	0.25	0.2	EPA-6010	12/03/02	12/05/02	20:09	ARD	TJA36E	5	253-105713	ND	A01	
Sodium	1300	mg/L	2.5	1	EPA-6010	12/03/02	12/05/02	20:09	ARD	TJA36E	5	253-105713	ND	A01	
Potassium	8	mg/L	5	2	EPA-6010	12/03/02	12/05/02	20:09	ARD	TJA36E	5	253-105713	ND	A01	
Total Cations	123	meq/L	0.275	0.039	Calculated						5				
Hydroxide	< PQL	mg/L	3.3	3.3	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	4	283-100816	ND		
Carbonate	< PQL	mg/L	6	6	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	4	283-100816	ND		
Bicarbonate	400	mg/L	12	12	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	4	283-100816	ND		
Sulfate	2090	mg/L	10	0.79	EPA-300.0	11/26/02	11/26/02	12:56	DPC	IC1	10	268-101875	ND	A01	
Chloride	2700	mg/L	5	0.33	EPA-300.0	11/26/02	11/26/02	12:56	DPC	IC1	10	268-101875	ND	A01	
Nitrate as N	9.0	mg/L	1	0.11	EPA-300.0	11/26/02	11/26/02	12:56	DPC	IC1	10	268-101875	ND	A01	
Nitrate as NO3	40	mg/L	0.1	0.05	Calculated										
Total Anions	127.	meq/L	0.1	0.1	Calculated										
pH	7.58	pH Units	0.05	0.05	EPA-9040	11/26/02	11/26/02	10:30	JSM	B360	1	257-101230			
Electrical Conductivity @ 25 C	10900	umhos/cm	1	1	EPA-9050	11/26/02	11/26/02	10:30	JSM	CND-3	1	196-101173			
TDS (by summation)	7450.	mg/L	10.		Calculated										
Hardness as CaCO3	3360	mg/L	2.5	0.50	SM-2340B						5				
Sodium Adsorption Ratio (SAR)	9.6	-	0.01		Calculated										
Adjusted Sodium Adsorption Ratio (SAR-adj)	30.	-	0.01		Calculated										

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Water Analysis (General Chemistry)

Sample Description		VWD,CYMRIC, CYM-17N1, 11/25/2002 @ 11:30, P.VANMIDDLESWORTH												
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Extractable Sodium Percentage (ESP)	11.	-	0.01		Calculated									
pHc	6.3	-	0.01		Calculated									
Gypsum Requirement	< PQL	#100% gyp./hr/100 gal./min.	0.01		Calculated									

Flag	Explanations
A01	PQL's and MDL's are raised due to sample dilution.

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Laboratories, Inc

Geomega Inc.

2995 Baseline Rd. Suite 202

Boulder, CO 80303

Attn: Jeff Anderson

Water Analysis (General Chemistry)

COC Number	---								Receive Date/Time		11/26/2002 @ 08:20			
Project Number	---								Sampling Date/Time		11/25/2002 @ 13:30			
Sampling Location	VWD,CYMRIC								Sample Depth		---			
Sampling Point	CYM-19H1								Sample Matrix		Groundwater			
Sampled By	P.VANMIDDLESWORTH								BCL Sample ID		02-12015-3			
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Calcium	760	mg/L	0.5	0.09	EPA-6010	12/03/02	12/05/02	20:12	ARD	TJA36E	10	253-105713	ND	A01
Magnesium	260	mg/L	0.5	0.4	EPA-6010	12/03/02	12/05/02	20:12	ARD	TJA36E	10	253-105713	ND	A01
Sodium	2500	mg/L	5	2	EPA-6010	12/03/02	12/05/02	20:12	ARD	TJA36E	10	253-105713	ND	A01
Potassium	12	mg/L	10	3	EPA-6010	12/03/02	12/05/02	20:12	ARD	TJA36E	10	253-105713	ND	A01
Total Cations	170	meq/L	0.55	0.078	Calculated						10			
Hydroxide	< PQL	mg/L	3.3	3.3	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	4	283-100816	ND	
Carbonate	< PQL	mg/L	6	6	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	4	283-100816	ND	
Bicarbonate	600	mg/L	12	12	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	4	283-100816	ND	
Sulfate	2420	mg/L	20	1.6	EPA-300.0	11/26/02	11/26/02	13:40	DPC	IC1	20	268-101875	ND	A01
Chloride	4120	mg/L	10	0.66	EPA-300.0	11/26/02	11/26/02	13:40	DPC	IC1	20	268-101875	ND	A01
Nitrate as N	22	mg/L	2	0.22	EPA-300.0	11/26/02	11/26/02	13:40	DPC	IC1	20	268-101875	ND	A01
Nitrate as NO3	95.5	mg/L	0.1	0.05	Calculated									
Total Anions	178.	meq/L	0.1	0.1	Calculated									
pH	7.20	pH Units	0.05	0.05	EPA-9040	11/26/02	11/26/02	10:30	JSM	B360	1	257-101230		
Electrical Conductivity @ 25 C	15600	umhos/cm	1	1	EPA-9050	11/26/02	11/26/02	10:30	JSM	CND-3	1	196-101173		
TDS (by summation)	10500.	mg/L	10.		Calculated									
Hardness as CaCO3	2990	mg/L	5	1.0	SM-2340B						10			
Sodium Adsorption Ratio (SAR)	20.	-	0.01		Calculated									
Adjusted Sodium Adsorption Ratio (SAR-adj)	65.	-	0.01		Calculated									



Laboratories, Inc

Water Analysis (General Chemistry)

Sample Description		VWD,CYMRIC, CYM-19H1, 11/25/2002 @ 13:30, P.VANMIDDLESWORTH												
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Extractable Sodium Percentage (ESP)	22.	-	0.01		Calculated									
pHc	6.2	-	0.01		Calculated									
Gypsum Requirement	< PQL	#100% gyp./hr/100 gal./min.	0.01		Calculated									

Flag	Explanations
A01	PQL's and MDL's are raised due to sample dilution.

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Laboratories, Inc

Geomega Inc.

2995 Baseline Rd. Suite 202

Boulder, CO 80303

Attn: Jeff Anderson

Water Analysis (General Chemistry)

COC Number	---	Receive Date/Time										11/26/2002 @ 08:20			
Project Number	---	Sampling Date/Time										11/25/2002 @ 14:30			
Sampling Location	VWD,CYMRIC	Sample Depth										---			
Sampling Point	CYM-1FWT	Sample Matrix										Groundwater			
Sampled By	P.VANMIDDLESWORTH	BCL Sample ID										02-12015-4			
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab	Quals
Calcium	25	mg/L	0.05	0.009	EPA-6010	12/03/02	12/13/02	18:03	ARD	TJA36E	1	253-105732	ND		
Magnesium	1.5	mg/L	0.05	0.04	EPA-6010	12/03/02	12/13/02	18:03	ARD	TJA36E	1	253-105732	ND		
Sodium	52	mg/L	0.5	0.2	EPA-6010	12/03/02	12/13/02	18:03	ARD	TJA36E	1	253-105732	ND		
Potassium	< PQL	mg/L	1	0.3	EPA-6010	12/03/02	12/13/02	18:03	ARD	TJA36E	1	253-105732	ND		
Total Cations	3.65	meq/L	0.055	0.008	Calculated						1				
Hydroxide	< PQL	mg/L	0.81	0.81	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	1	283-100816	ND		
Carbonate	3.4	mg/L	1.5	1.5	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	1	283-100816	ND		
Bicarbonate	110	mg/L	2.9	2.9	EPA-310.1	11/27/02	11/27/02	15:00	JSM	BDB	1	283-100816	ND		
Sulfate	35	mg/L	1	0.079	EPA-300.0	11/26/02	11/26/02	11:23	DPC	IC1	1	268-101875	ND		
Chloride	20	mg/L	0.5	0.033	EPA-300.0	11/26/02	11/26/02	11:23	DPC	IC1	1	268-101875	ND		
Nitrate as N	1.40	mg/L	0.1	0.011	EPA-300.0	11/26/02	11/26/02	11:23	DPC	IC1	1	268-101875	ND		
Nitrate as NO3	6.19	mg/L	0.1	0.05	Calculated										
Total Anions	3.21	meq/L	0.1	0.1	Calculated										
pH	8.21	pH Units	0.05	0.05	EPA-9040	11/26/02	11/26/02	10:30	JSM	B360	1	257-101230			
Electrical Conductivity @ 25 C	389	umhos/cm	1	1	EPA-9050	11/26/02	11/26/02	10:30	JSM	CND-3	1	196-101173			
TDS (by summation)	192.	mg/L	10.		Calculated										
Hardness as CaCO3	69.	mg/L	0.5	0.10	SM-2340B						1				
Sodium Adsorption Ratio (SAR)	2.7	-	0.01		Calculated										
Adjusted Sodium Adsorption Ratio (SAR-adj)	3.6	-	0.01		Calculated										

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Water Analysis (General Chemistry)

Sample Description		VWD,CYMRIC, CYM-1FWT, 11/25/2002 @ 14:30, P.VANMIDDLESWORTH												
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Extractable Sodium Percentage (ESP)	2.7	-	0.01		Calculated									
pHc	8.1	-	0.01		Calculated									
Gypsum Requirement	2.4	#100% gyp./hr/100 gal./min.	0.01		Calculated									

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02-12015 4


Laboratories, Inc

Geomega Inc.

2995 Baseline Rd. Suite 202

Boulder, CO 80303

Attn: Jeff Anderson

Water Analysis (Metals)

COC Number	---					Receive Date/Time	11/26/2002 @ 08:20							
Project Number	---					Sampling Date/Time	11/24/2002 @ 11:00							
Sampling Location	VWD,CYMRIC					Sample Depth	---							
Sampling Point	CYM-21D1					Sample Matrix	Groundwater							
Sampled By	P.VANMIDDLESWORTH					BCL Sample ID	02-12015-1							
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved Boron	2.5	mg/L	0.1	0.005	EPA-6010	12/03/02	12/05/02	20:05	ARD	TJA36E	1	253-105713	ND	

Comments

Sample was filtered thru 0.45 u filter and acidified prior to metal analysis.

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02-12015-1



Geomega Inc.
2995 Baseline Rd. Suite 202
Boulder, CO 80303
Attn: Jeff Anderson

Water Analysis (Metals)

COC Number	---										Receive Date/Time	11/26/2002 @ 08:20			
Project Number	---										Sampling Date/Time	11/25/2002 @ 11:30			
Sampling Location	VWD,CYMRIC										Sample Depth	---			
Sampling Point	CYM-17N1										Sample Matrix	Groundwater			
Sampled By	P.VANMIDDLESWORTH										BCL Sample ID	02-12015-2			
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab	Quals
Dissolved Boron	20	mg/L	0.5	0.03	EPA-6010	12/03/02	12/05/02	20:09	ARD	TJA36E	5	253-105713	ND	A01	

Flag	Explanations
A01	PQL's and MDL's are raised due to sample dilution.
Comments	
Sample was filtered thru 0.45 u filter and acidified prior to metal analysis.	

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02-12015-2



Geomega Inc.
2995 Baseline Rd. Suite 202
Boulder, CO 80303
Attn: Jeff Anderson

Water Analysis (Metals)

COC Number	---								Receive Date/Time		11/26/2002 @ 08:20			
Project Number	---								Sampling Date/Time		11/25/2002 @ 13:30			
Sampling Location	VWD,CYMRIC								Sample Depth		---			
Sampling Point	CYM-19H1								Sample Matrix		Groundwater			
Sampled By	P.VANMIDDLESWORTH								BCL Sample ID		02-12015-3			
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab. Quals
Dissolved Boron	36	mg/L	1	0.05	EPA-6010	12/03/02	12/05/02	20:12	ARD	TJA36E	10	253-105713	ND	A01

Flag	Explanations
A01	PQL's and MDL's are raised due to sample dilution.
Comments	
Sample was filtered thru 0.45 u filter and acidified prior to metal analysis.	

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Geomega Inc.
 2995 Baseline Rd. Suite 202
 Boulder, CO 80303
 Attn: Jeff Anderson

Water Analysis (Metals)

COC Number	---								Receive Date/Time		11/26/2002 @ 08:20				
Project Number	---								Sampling Date/Time		11/25/2002 @ 14:30				
Sampling Location	VWD,CYMRIC								Sample Depth		---				
Sampling Point	CYM-1FWT								Sample Matrix		Groundwater				
Sampled By	P.VANMIDDLESWORTH								BCL Sample ID		02-12015-4				
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instru-ment ID	Dilution	QC Batch ID	MB Bias	Lab Quals	
Dissolved Boron	0.49	mg/L	0.1	0.005	EPA-6010	12/03/02	12/05/02	20:42	ARD	TJA36E	1	253-105713	ND		

Comments

Sample was filtered thru 0.45 u filter and acidified prior to metal analysis.

California DOHS Certification #1186

All results listed in this report are for the exclusive use of the submitting party. BC Laboratories, Inc. assumes no responsibility for report alteration, separation, detachment or third party interpretation.

4100 Atlas Court * Bakersfield, CA 93308 * (661) 327-4911 * FAX (661) 327-1918 * www.bclabs.com

Printed 12/12/2002 16:13:00

02-12015-4



B C LABORATORIES
QUALITY CONTROL REPORT
(Precision & Accuracy)

Geomega Inc.
2995 Baseline Rd. Suite 202
Boulder, CO 80303
Jeff Anderson

Date of Report: 12/26/2002
Sample Matrix: Groundwater
QC Batch ID: 200212015-1*WATER

Samples Affected: 02-12015-1 - 02-12015-3

Constituents	QC Sample ID	Sample Result	Sample Duplicate	MS Result	MSD Result	MS Spike Level	MSD Spike Level	Units	Sample R.P.D.	Spike R.P.D.	Precision Control Limits	MS % Rec	MSD % Rec	Accuracy Control Limits
Calcium	DISS-11992-1-B	91.64	90.75	100.2	98.11	10.2	10.2	mg/L	1.	2.	20	H MEAN	H MEAN	85 - 1
Magnesium	DISS-11992-1-B	51.67	50.96	61.26	59.86	10.2	10.2	mg/L	1.	2.	20	H MEAN	H MEAN	85 - 1
Sodium	DISS-11992-1-B	26.1	25.35	35.89	34.73	10.2	10.2	mg/L	3.	3.	20	96.	85.	85 - 1
Potassium	DISS-11992-1-B	2.883	2.749	13.88	13.46	10.2	10.2	mg/L	<PQL	3.	20	108.	104.	85 - 1
Hydroxide	12015-2-B1	< 3.3	< 3.3					mg/L	<PQL		10			
Carbonate	12015-2-B1	< 6.	< 6.					mg/L	<PQL		10			
Bicarbonate	12015-2-B1	396.5	401.1	709.5	707.2	304.8	304.8	mg/L	1.	0.	10	103.	102.	80 - 1
Sulfate	12015-4-B1	34.83	34.83	138.9	139.1	100.0	100.0	mg/L	0.	0.	10	104.	104.	80 - 1
Chloride	12015-4-B1	20.17	20.30	124.3	124.3	100.0	100.0	mg/L	1.	0.	10	104.	104.	80 - 1
Nitrate as N	12015-4-B1	1.399	1.422	6.449	6.425	5.000	5.000	mg/L	2.	0.	10	101.	101.	80 - 1
pH	11955-1-B1	5.68	5.69					pH Units	0.		± .1 PH UN			
Electrical Conductivity @ 25 C	11955-1-B1	18000.	18000.					umhos/cm	0.		10			

MS = Matrix Spike; MSD = Matrix Spike Duplicate; RPD = Relative Percent Difference

H Mean - sample concentration is greater than four times the spike level.

Quality Control Officer

Danette Bohm



B C LABORATORIES
QUALITY CONTROL REPORT
(Precision & Accuracy)

Geomega Inc.
2995 Baseline Rd. Suite 202
Boulder, CO 80303
Jeff Anderson

Date of Report: 12/26/2002
Sample Matrix: Groundwater
QC Batch ID: 200212015-4*WATER

Samples Affected: 02-12015-4

Constituents	QC Sample ID	Sample Result	Sample Duplicate	MS Result	MSD Result	MS Spike Level	MSD Spike Level	Units	Sample R.P.D.	Spike R.P.D.	Precision Control Limits	MS % Rec	MSD % Rec	Accuracy Control Limits
Calcium	TAD-12398-1-B2	60.44	60.12	69.57	69.19	10.2	10.2	mg/L	1.	1.	20	H MEAN	H MEAN	85 - 11
Magnesium	TAD-12398-1-B2	15.64	15.53	26.39	26.23	10.2	10.2	mg/L	1.	1.	20	105.	104.	85 - 11
Sodium	TAD-12398-1-B2	17.22	17.04	26.89	26.66	10.2	10.2	mg/L	1.	1.	20	95.	93.	85 - 11
Potassium	TAD-12398-1-B2	4.893	4.793	15.53	15.56	10.2	10.2	mg/L	<PQL	0.	20	104.	105.	85 - 11
Hydroxide	12015-2-B1	< 3.3	< 3.3					mg/L	<PQL		10			
Carbonate	12015-2-B1	< 6.	< 6.					mg/L	<PQL		10			
Bicarbonate	12015-2-B1	396.5	401.1	709.5	707.2	304.8	304.8	mg/L	1.	0.	10	103.	102.	80 - 12
Sulfate	12015-4-B1	34.83	34.83	138.9	139.1	100.0	100.0	mg/L	0.	0.	10	104.	104.	80 - 12
Chloride	12015-4-B1	20.17	20.30	124.3	124.3	100.0	100.0	mg/L	1.	0.	10	104.	104.	80 - 12
Nitrate as N	12015-4-B1	1.399	1.422	6.449	6.425	5.000	5.000	mg/L	2.	0.	10	101.	101.	80 - 12
pH	11955-1-B1	5.68	5.69					pH Units	0.		± .1 PH UN			
Electrical Conductivity @ 25 C	11955-1-B1	18000.	18000.					umhos/cm	0.		10			

MS = Matrix Spike; MSD = Matrix Spike Duplicate; RPD = Relative Percent Difference

H Mean - sample concentration is greater than four times the spike level.

Quality Control Officer

Danette Bohm



B C LABORATORIES
QUALITY CONTROL REPORT
(Precision & Accuracy)

Geomega Inc.
2995 Baseline Rd. Suite 202
Boulder, CO 80303
Jeff Anderson

Date of Report: 12/26/2002
Sample Matrix: Groundwater
QC Batch ID: 200212015-1*METALS

Samples Affected: 02-12015-1 - 02-12015-4

Constituents	QC Sample ID	Sample Result	Sample Duplicate	MS Result	MSD Result	MS Spike Level	MSD Spike Level	Units	Sample R.P.D.	Spike R.P.D.	Precision Control Limits	MS % Rec	MSD % Rec	Accuracy Control Limits
Dissolved Boron	DISS-11992-1-B	0.0858	0.0844	1.114	1.097	1.02	1.02	mg/L	<PQL	2.	20	101.	99.	85 - 11

MS = Matrix Spike; MSD = Matrix Spike Duplicate; RPD = Relative Percent Difference

Quality Control Officer


Danette Bohm

BC

Laboratories, Inc.

Chain of Custody Form

32110

PLEASE COMPLETE
BCL QUOTE ID:Page 1 of 1

Client: GEOMEGA Project #: _____
 Contact: Jeff Anderson Project Name: VWD - Cymric
 Street Address: 2995 Baseline Rd. Project Code: _____
 City, State, Zip: Boulder, CO 80303 Sampler(s): P. Van Middelburg
 Phone: (303) 443-9117 Fax: (303) 898-4688
 Email Address: jeff@geomega.com
 Submission #: 02-12015

Analysis Requested

Comments:

Please refer to the back of this page for completion instructions and method legend.

Sample #	Description	Date Sampled	Time Sampled
----------	-------------	--------------	--------------

-1	CYM-21DI	11/24/02	11:00
-2	CYM-17NI	11/25/02	11:30
-3	CYM-19HI	11/25/02	13:30
-4	CYM-1FWT	11/25/02	14:30

Sample Matrix

Soil	Sludge	Drinking Water	Ground Water	Waste Water	Other
------	--------	----------------	--------------	-------------	-------

Are there any tests with holding times less than 48 hours?

☒ Yes ☐ No

* Standard Turnaround = 15 work days

Notes

CHK BY DISTRIBUTION

180

MAIBG

SUB OUT

SHORT HOLDING TIME

Cr ⁶⁺	NO ₂	NO ₃	OP	SR
DO	BOD	MEAS	C	O

Billing

☒ Same as above

Report Drinking Waters on State Form?

☐ Yes ☒ No

Send Copy to State of CA?

☐ Yes ☒ No

Sample Disposal

☐ Return to Client ☒ Disposal by lab ☐ Archive: Months _____
1. Relinquished By P. Van Middelburg Date 11/26/02 Time 8:20

2. Relinquished By _____ Date _____ Time _____

3. Relinquished By _____ Date _____ Time _____

Special Reporting

☐ QC ☐ WIP ☐ Raw Data
1. Received By Melanie Erickson Date 11/26/02 Time 8:20

2. Received By _____ Date _____ Time _____

3. Received By _____ Date _____ Time _____

Submission #: 02-12015

Project Code:

TB Batch #

SHIPPING INFORMATION

Federal Express ☐ UPS ☐ Hand Delivery ☒
BC Lab Field Service ☐ Other ☐ (Specify) _____

SHIPPING CONTAINER

Ice Chest ☒ None ☐
Box ☐ Other ☐ (Specify) _____

Refrigerant: Ice ☒ Blue Ice ☐ None ☐ Other ☐ Comments:

Custody Seals: Ice Chest ☐ Container ☐ None ☒ Comments:

All samples received? Yes ☒ No ☐ All samples containers intact? Yes ☒ No ☐ Description(s) match COC? Yes ☒ No ☐

COC Received
☒ YES ☐ NO

Ice Chest ID
Temperature: 1.2 °C
Thermometer ID: 80

Emissivity 1.00
Container WPE

Date/Time 11/26/02
8:20
Analyst Init me

SAMPLE CONTAINERS	SAMPLE NUMBERS									
	1	2	3	4	5	6	7	8	9	10
QT GENERAL MINERAL/ GENERAL PHYSICAL										
PT PE UNPRESERVED										
QT INORGANIC CHEMICAL METALS										
PT INORGANIC CHEMICAL METALS										
PT CYANIDE										
PT NITROGEN FORMS										
PT TOTAL SULFIDE										
2oz. NITRATE / NITRITE										
100ml TOTAL ORGANIC CARBON										
QT TOX										
PT CHEMICAL OXYGEN DEMAND										
100ml PHENOLICS										
40ml VOA VIAL TRAVEL BLANK										
40ml VOA VIAL										
A SET	()	()	()	()	()	()	()	()	()	()
EPA 413.1, 413.2, 418.1										
PT ODOR										
RADIOLOGICAL										
BACTERIOLOGICAL										
PT EPA 504										
QT EPA 508/608/8080										
QT EPA 515.1/8150										
QT EPA 525										
QT EPA 525 TRAVEL BLANK										
100ml EPA 547										
100ml EPA 531.1										
QT EPA 548										
QT EPA 549										
QT EPA 632										
QT EPA 8015M										
QT QA/QC										
QT AMBER										
8 OZ. JAR										
32 OZ. JAR										
SOIL SLEEVE										
PCB VIAL										
PLASTIC BAG										

Notes:

Sample Numbering Completed By: SC Date/Time: 11/26 0900



Laboratories, Inc.

Cover Report

VALLEY WASTE DISPOSAL CO
1400 EASTON DR
SUITE 139B
BAKERSFIELD, CA 93309
Attn: LARRY BRIGHT

Project Number:
COC Number:
BCL Number: 03-00457

Dear Mr. Bright:

This report contains the analytical results for the samples received under chain of custody by BC Laboratories, Inc. The samples were logged into the Laboratory Information Management System (LIMS) and BC Lab numbers were assigned to each sample. The result of the temperature check, condition of the samples and any other discrepancies were recorded on the cooler receipt form.

All applicable quality control procedures met method-specific acceptance criteria, except as noted on the following analytical and quality control reports.

This report shall not be reproduced except in full, without written approval of the laboratory.

California DOHS Certification #1186

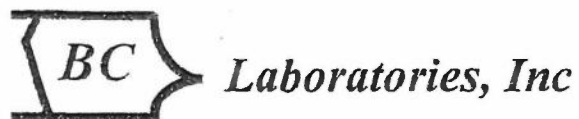
Authorized Signature



VALLEY WASTE DISPOSAL CO
 100 EASTON DR
 SUITE 139B
 WAKERSFIELD, CA 93309
 Attn: LARRY BRIGHT

Water Analysis (General Chemistry)

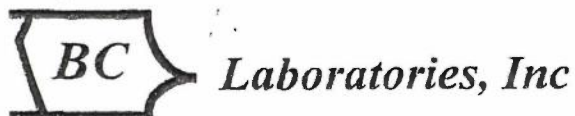
Job Number	---									Receive Date/Time	01/15/2003 @ 08:10			
Project Number	---									Sampling Date/Time	01/14/2003 @ 15:00			
Sampling Location	MCKITTRICK STUDY									Sample Depth	---			
Sampling Point	PRODUCED WATER									Sample Matrix	Water			
Sampled By	LARRY MILLER									BCL Sample ID	03-00457-1			
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Calcium	120	mg/L	2	0.13	EPA-6010	01/16/03	01/24/03	14:31	MPG2	PE-OP2	20	385-100246	ND	A01
Magnesium	66	mg/L	1	0.078	EPA-6010	01/16/03	01/24/03	14:31	MPG2	PE-OP2	20	385-100246	ND	A01
Sodium	2900	mg/L	10	0.14	EPA-6010	01/16/03	01/24/03	14:31	MPG2	PE-OP2	20	385-100246	ND	A01
Potassium	55	mg/L	20	0.46	EPA-6010	01/16/03	01/24/03	14:31	MPG2	PE-OP2	20	385-100246	ND	A01
Total Cations	137.	meq/L	0.1	0.1	Calculated									
Hydroxide	< PQL	mg/L	6.5	6.5	EPA-310.1	01/20/03	01/20/03	10:20	JSM	BDB	8	283-100853	ND	A01
Bicarbonate	< PQL	mg/L	12	12	EPA-310.1	01/20/03	01/20/03	10:20	JSM	BDB	8	283-100853	ND	A01
Carbonate	1500	mg/L	24	24	EPA-310.1	01/20/03	01/20/03	10:20	JSM	BDB	8	283-100853	ND	A01
Sulfate	170	mg/L	20	1.6	EPA-300.0	01/16/03	01/16/03	05:27	DPC	IC1	20	268-101953	ND	A01
Chloride	4520	mg/L	10	0.66	EPA-300.0	01/16/03	01/16/03	05:27	DPC	IC1	20	268-101953	ND	A01
Ammonia as N	< PQL	mg/L	2	0.22	EPA-300.0	01/16/03	01/16/03	05:27	DPC	IC1	20	268-101953	ND	A01
Nitrate as NO3	< PQL	mg/L	0.1	0.05	Calculated									
Total Anions	155.	meq/L	0.1	0.1	Calculated									
pH	7.61	pH Units	0.05	0.05	EPA-9040	01/16/03	01/16/03	11:25	JSM	B360	1	257-101284		
Electrical Conductivity @ 25 C	14600	umhos/cm	1	1	EPA-9050	01/16/03	01/16/03	11:07	JSM	CND-3	1	196-101243		
TDS (by summation)	8500.	mg/L	10.		Calculated									
Hardness as CaCO3	570	mg/L	0.5		SM-2340B									
Sodium Adsorption Ratio (SAR)	52.	-	0.01		Calculated									
Adjusted Sodium Adsorption Ratio (AR-adj)	151.	-	0.01		Calculated									



Water Analysis (General Chemistry)

Sample Description		MCKITTRICK STUDY, PRODUCED WATER, 01/14/2003 @ 15:00, LARRY MILLER												
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Extractable Sodium Percentage (SP)	43.	-	0.01		Calculated									
Calc	6.5	-	0.01		Calculated									
Gypsum Requirement	53.	#100% gyp./hr/100 gal./min.	0.01		Calculated									

Tag	Explanations
01	PQL's and MDL's are raised due to sample dilution.



Laboratories, Inc

VALLEY WASTE DISPOSAL CO

00 EASTON DR

SUITE 139B

WAKERSFIELD, CA 93309

Attn: LARRY BRIGHT

Water Analysis (Metals)

QC Number	---								Receive Date/Time		01/15/2003 @ 08:10			
Project Number	---								Sampling Date/Time		01/14/2003 @ 15:00			
Sampling Location	MCKITTRICK STUDY								Sample Depth		---			
Sampling Point	PRODUCED WATER								Sample Matrix		Water			
Sampled By	LARRY MILLER								BCL Sample ID		03-00457-1			
Constituent	Result	Units	PQL	MDL	Method	Prep Date	Run Date	Run Time	Analyst	Instrument ID	Dilution	QC Batch ID	MB Bias	Lab Quals
Dissolved Boron	54000	ua/L	2000	90	EPA-6010	01/16/03	01/24/03	14:31	MPG2	PE-OP2	20	385-100246	ND	A01

Tag	Explanations
01	PQL's and MDL's are raised due to sample dilution.
Comments	
Sample was filtered thru 0.45 u filter and acidified prior to metal analysis.	

Chain of Custody Form

PLEASE COMPLETE:
BCL QUOTE ID:

23253

Page _____ of _____

Project #:	VALLEY WASTE DISPOSAL	Project #:	WATER STUDY
Address:	LARRY BRIGHT	Project Name:	
Address:	1400 EASTON #139 B	Project Code:	
State, Zip:	BKSF, CA 93309	Sampler(s):	LARRY MILLER
Phone:	322 5004 Fax: 322 6396		
Address:			
Initial #:	0.3 00457		

Analysis Requested	
Investigation	<p>Recoverer for the back of the page of contact from as a tactic and method of legend.</p>
	<p>San</p>

Comments:

[illegible][illegible][illegible]

<input checked="" type="checkbox"/> Same as above : _____ SS: _____ _____ State _____ Zip _____		Report Drinking Waters on State Form? <input type="checkbox"/> Yes <input type="checkbox"/> No Send Copy to State of CA? <input type="checkbox"/> Yes <input type="checkbox"/> No		Sample Disposal <input type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by lab <input type="checkbox"/> Archive: Months _____			Special Reporting <input type="checkbox"/> QC <input type="checkbox"/> WIP <input type="checkbox"/> Raw Data		
				1. Relinquished By <u>Pamela Miller</u> Date <u>1/15/03</u> Time <u>8:10 AM</u>		1. Received By <u>Melanie Erickson</u> Date <u>1/15/03</u> Time <u>8:10 AM</u>			
				2. Relinquished By _____ Date _____ Time _____		2. Received By _____ Date _____ Time _____			
				3. Relinquished By _____ Date _____ Time _____		3. Received By _____ Date _____ Time _____			

Submission #: 03-00457 | Project Code:

TB Batch #

SHIPPING INFORMATION

Federal Express ☐ UPS ☐ Hand Delivery ☒
BC Lab Field Service ☐ Other ☐ (Specify) _____

SHIPPING CONTAINER

Ice Chest ☐ None ☒
Box ☐ Other ☐ (Specify) _____Refrigerant: Ice ☐ Blue Ice ☐ None ☒ Other ☐ Comments:Custody Seals: Ice Chest ☒ Containers ☒ None ☒ Comments:Intact? Yes ☒ No ☐Intact? Yes ☒ No ☐All samples received? Yes ☒ No ☐All samples containers intact? Yes ☒ No ☐Description(s) match COC? Yes ☒ No ☐COC Received
☒ YES ☐ NOIce Chest ID
Temperature: 12.2 °C WU
Thermometer ID: 48 V-15-03
Emissivity
Container 95 QTPDate/Time 1/15/03
Analyst Init me

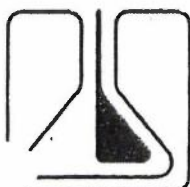
SAMPLE CONTAINERS

SAMPLE NUMBERS

	1	2	3	4	5	6	7	8	9	10
QT GENERAL MINERAL/ GENERAL PHYSICAL	1									
PT PE UNPRESERVED										
QT INORGANIC CHEMICAL METALS										
PT INORGANIC CHEMICAL METALS										
PT CYANIDE										
PT NITROGEN FORMS										
PT TOTAL SULFIDE										
2oz. NITRATE / NITRITE										
100ml TOTAL ORGANIC CARBON										
QT TOX										
PT CHEMICAL OXYGEN DEMAND										
100ml PHENOLICS										
40ml VOA VIAL TRAVEL BLANK										
VOA VIAL										
ET	()	()	()	()	()	()	()	()	()	()
EPA 413.1, 413.2, 418.1										
PT ODOR										
RADIOLOGICAL										
BACTERIOLOGICAL										
PT EPA 504										
QT EPA 508/608/8080										
QT EPA 515.1/8150										
QT EPA 525										
QT EPA 525 TRAVEL BLANK										
100ml EPA 547										
100ml EPA 531.1										
QT EPA 548										
QT EPA 549										
QT EPA 632										
QT EPA 8015M										
QT QA/QC										
QT AMBER										
8 OZ. JAR										
32 OZ. JAR										
SOIL SLEEVE										
PCB VIAL										
PLASTIC BAG										

Comments:

Sample Numbering Completed By: SIC Date/Time: 1/15 15:35



ZALCO LABORATORIES, INC.
Analytical & Consulting Services

4309 Armour Avenue
Bakersfield, California 93308

(661) 395-0539
FAX (661) 395-3069

Valley Waste Disposal
1400 Easton Drive Suite 139B
Bakersfield, CA 93309

Attention: Larry Bright

Sample Type: Water

Description: McKittrick Water Study
Sampled by Larry Miller

Laboratory No: 0301179-1
Date Received: 01/15/03
Date Reported: 01/21/03
Contract No. :
Date Sampled : 01/14/03
Time Sampled : 14:00

REPORT OF ANALYTICAL RESULTS

Constituents	Results	Units	DLR	Method/Ref
TPH Crude Oil				
Gasoline Range Organics C4-C10	ND	mg/l	0.5	8015B/1
Diesel Range Organics C11-C25	3.8	mg/l	0.5	8015B/1
Crude Oil Range Organics C26-C40	ND	mg/l	0.5	8015B/1
Total Crude Oil Organics C4-C40	3.8	mg/l		8015B/1
Purgeable Aromatics 8020				
Methyl tert-Butyl Ether (MTBE)	ND	ug/L	0.3	8020/1
Benzene	0.60	ug/L	0.3	8020/1
Toluene	0.31	ug/L	0.3	8020/1
Ethylbenzene	ND	ug/L	0.3	8020/1
Total Xylenes	2.6	ug/L	0.6	8020/1

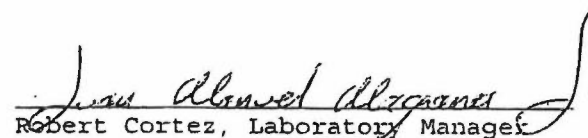
Analyzed : 01/16/03

RB

cc:

Method Reference

1. EPA SW-846, 1994 3rd Edition

For 
Robert Cortez, Laboratory Manager

mg/L : milligrams per Liter (parts per million)
ug/L : micrograms per Liter (parts per billion)
umhos/cm : micromhos/cm at 25 C
mmhos/cm : millimhos/cm at 25 C
ND : None Detected N/A : Not Applicable
NSS : Not Sufficient Sample for Analysis
DLR : Detection Limit for Reporting Purposes



ZALCO LABORATORIES, INC.
Analytical & Consulting Services

4309 Armour Avenue
Bakersfield, California 93308

(661) 395-0539
FAX (661) 395-3069

Geomega, Inc.
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Attention: Jeff Anderson

Sample Type: Water

Description: VWD-Cyric, CYM-1FWT
Sampled by P. Van Middlesworth

Laboratory No: 0211318-4
Date Received: 11/26/02
Date Reported: 12/06/02
Contract No. :
Date Sampled : 11/24/02
Time Sampled : 14:30

REPORT OF ANALYTICAL RESULTS

Constituents	Results	Units	DLR	Method/Ref
TPH Crude Oil				
Gasoline Range Organics C4-C10	ND	mg/l	0.5	8015B/1
Diesel Range Organics C11-C25	ND	mg/l	0.5	8015B/1
Crude Oil Range Organics C26-C40	ND	mg/l	1.3	8015B/1
Total Crude Oil Organics C4-C40	ND	mg/l		8015B/1

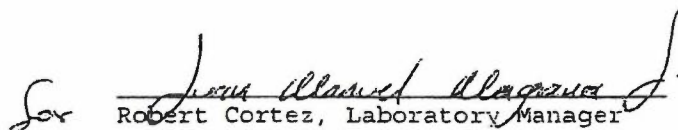
Analyzed : 12/03/02

JOV

cc:

Method Reference

1. EPA SW-846, 1994 3rd Edition

For 
Robert Cortez, Laboratory Manager

mg/L : milligrams per Liter (parts per million)
ug/L : micrograms per Liter (parts per billion)
umhos/cm : micromhos/cm at 25 C
mmhos/cm : millimhos/cm at 25 C
ND : None Detected N/A : Not Applicable
NSS : Not Sufficient Sample for Analysis
DLR : Detection Limit for Reporting Purposes



ZALCO LABORATORIES, INC.
Analytical & Consulting Services

4309 Armour Avenue
Bakersfield, California 93308

(661) 395-0539
FAX (661) 395-3069

Geomega, Inc.
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Attention: Jeff Anderson

Sample Type: Water

Description: VWD-Cymric, CYM-19H1
Sampled by P. Van Middlesworth

Laboratory No: 0211318-3
Date Received: 11/26/02
Date Reported: 12/06/02
Contract No. :
Date Sampled : 11/24/02
Time Sampled : 13:30

REPORT OF ANALYTICAL RESULTS

Constituents	Results	Units	DLR	Method/Ref
TPH Crude Oil				
Gasoline Range Organics C4-C10	ND	mg/l	0.5	8015B/1
Diesel Range Organics C11-C25	3.9	mg/l	0.5	8015B/1
Crude Oil Range Organics C26-C40	ND	mg/l	1.3	8015B/1
Total Crude Oil Organics C4-C40	3.9	mg/l		8015B/1

Analyzed : 12/03/02

JOV

cc:

Method Reference

1. EPA SW-846, 1994 3rd Edition

For Juan Manuel Alagana
Robert Cortez, Laboratory Manager

mg/L : milligrams per Liter (parts per million)
ug/L : micrograms per Liter (parts per billion)
umhos/cm : micromhos/cm at 25 C
mmhos/cm : millimhos/cm at 25 C
ND : None Detected N/A : Not Applicable
NSS : Not Sufficient Sample for Analysis
DLR : Detection Limit for Reporting purposes



ZALCO LABORATORIES, INC.

Analytical & Consulting Services

4309 Armour Avenue
Bakersfield, California 93308

(661) 395-0539
FAX (661) 395-3069

Geomega, Inc.
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Attention: Jeff Anderson

Sample Type: Water

Description: VWD-Cymric, CYM-17N1
Sampled by P. Van Middlesworth

Laboratory No: 0211318-2
Date Received: 11/26/02
Date Reported: 12/06/02
Contract No. :
Date Sampled : 11/24/02
Time Sampled : 11:30

REPORT OF ANALYTICAL RESULTS

Constituents	Results	Units	DLR	Method/Ref
TPH Crude Oil				
Gasoline Range Organics C4-C10	ND	mg/l	0.5	8015B/1
Diesel Range Organics C11-C25	ND	mg/l	0.5	8015B/1
Crude Oil Range Organics C26-C40	ND	mg/l	1.3	8015B/1
Total Crude Oil Organics C4-C40	ND	mg/l		8015B/1

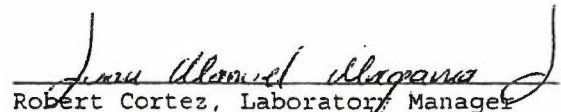
Analyzed : 12/03/02

JOV

cc:

Method Reference

1. EPA SW-846, 1994 3rd Edition

For 
Robert Cortez, Laboratory Manager

mg/L : milligrams per Liter (parts per million)
ug/L : micrograms per Liter (parts per billion)
umhos/cm : micromhos/cm at 25 C
mmhos/cm : millimhos/cm at 25 C
ND : None Detected N/A : Not Applicable
NSS : Not Sufficient Sample for Analysis
DLR : Detection Limit for Reporting Purposes



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Bakersfield, California 93308

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FAX (661) 395-3069

Geomega, Inc.
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Attention: Jeff Anderson

Sample Type: Water

Description: VWD-Cymric, CYM-21D1
Sampled by P. Van Middlesworth

Laboratory No: 0211318-1
Date Received: 11/26/02
Date Reported: 12/06/02
Contract No. :
Date Sampled : 11/24/02
Time Sampled : 11:00

REPORT OF ANALYTICAL RESULTS

Constituents	Results	Units	DLE	Method/Ref
TPH Crude Oil				
Gasoline Range Organics C4-C10	ND	mg/l	0.5	8015B/1
Diesel Range Organics C11-C25	ND	mg/l	0.5	8015B/1
Crude Oil Range Organics C26-C40	ND	mg/l	1.3	8015B/1
Total Crude Oil Organics C4-C40	ND	mg/l		8015B/1

Analyzed : 12/03/02

JOV

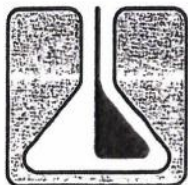
cc:

Method Reference

1. EPA SW-846, 1994 3rd Edition

For *Juan Manuel Alagona*
Robert Cortez, Laboratory Manager

mg/L : milligrams per Liter (parts per million)
ug/L : micrograms per Liter (parts per billion)
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Geomega, Inc.
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Attention: Jeff Anderson

Sample Type: Water

Description: VWD-Cyric, CYM-1FWT
Sampled by P. Van Middlesworth

Laboratory No: 0211318-4
Date Received: 11/26/02
Date Reported: 12/06/02
Contract No. :
Date Sampled : 11/24/02
Time Sampled : 14:30

REPORT OF ANALYTICAL RESULTS

Constituents	Results	Units	DLR	Method/Ref
Purgeable Aromatics 8020				
Methyl tert-Butyl Ether (MTBE)	ND	ug/L	0.3	8020/1
Benzene	ND	ug/L	0.3	8020/1
Toluene	ND	ug/L	0.3	8020/1
Ethylbenzene	ND	ug/L	0.3	8020/1
Total Xylenes	ND	ug/L	0.6	8020/1

Analyzed : 12/03/02

JOV

cc:

Method Reference

1. EPA SW-846, 1994 3rd Edition

Robert Cortez
Robert Cortez, Laboratory Manager

mg/L : milligrams per Liter (parts per million)
ug/L : micrograms per Liter (parts per billion)
umhos/cm : micromhos/cm at 25 C
mmhos/cm : millimhos/cm at 25 C
ND : None Detected N/A : Not Applicable
NSS : Not Sufficient Sample for Analysis
DLR : Detection Limit for Reporting Purposes



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4309 Armour Avenue
Bakersfield, California 93308

(661) 395-0539
FAX (661) 395-3069

Geomega, Inc.
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Attention: Jeff Anderson

Sample Type: Water

Description: VWD-Cymric, CYM-19H1
Sampled by P. Van Middlesworth

Laboratory No: 0211318-3
Date Received: 11/26/02
Date Reported: 12/06/02
Contract No. :
Date Sampled : 11/24/02
Time Sampled : 13:30

REPORT OF ANALYTICAL RESULTS

Constituents	Results	Units	DLR	Method/Ref
Purgeable Aromatics 8020				
Methyl tert-Butyl Ether (MTBE)	ND	ug/L	0.3	8020/1
Benzene	ND	ug/L	0.3	8020/1
Toluene	ND	ug/L	0.3	8020/1
Ethylbenzene	ND	ug/L	0.3	8020/1
Total Xylenes	ND	ug/L	0.6	8020/1

Analyzed : 12/03/02

JOV

cc:

Method Reference

1. EPA SW-846, 1994 2nd Edition

For Juan Manuel Alagona J.
Robert Cortez, Laboratory Manager

mg/L : milligrams per Liter (parts per million)
ug/L : micrograms per Liter (parts per billion)
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mmhos/cm : millimhos/cm at 25 C
ND : None Detected N/A : Not Applicable
NSS : Not Sufficient Sample for Analysis
DLR : Detection Limit for Reporting Purposes



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Bakersfield, California 93308

(661) 395-0539
FAX (661) 395-3069

Geomega, Inc.
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Attention: Jeff Anderson

Sample Type: Water

Description: VWD-Cymric, CYM-17N1
Sampled by P. Van Middlesworth

Laboratory No: 0211318-2
Date Received: 11/26/02
Date Reported: 12/06/02
Contract No. :
Date Sampled : 11/24/02
Time Sampled : 11:30

REPORT OF ANALYTICAL RESULTS

Constituents	Results	Units	DLR	Method/Ref
Purgeable Aromatics 8020				
Methyl tert-Butyl Ether (MTBE)	ND	ug/L	0.3	8020/1
Benzene	ND	ug/L	0.3	8020/1
Toluene	ND	ug/L	0.3	8020/1
Ethylbenzene	ND	ug/L	0.3	8020/1
Total Xylenes	ND	ug/L	0.6	8020/1

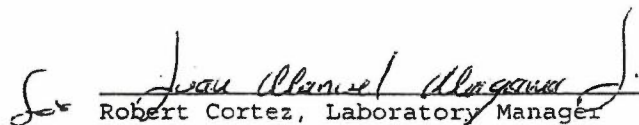
Analyzed : 12/03/02

JOV

cc:

Method Reference

1. EPA SW-846, 1994 3rd Edition


Robert Cortez, Laboratory Manager

mg/L : milligrams per Liter (parts per million)
ug/L : micrograms per Liter (parts per billion)
umhos/cm : micromhos/cm at 25 C
mmhos/cm : millimhos/cm at 25 C
ND : None Detected N/A : Not Applicable
NSS : Not Sufficient Sample for Analysis
DLR : Detection Limit for Reporting Purposes



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4309 Armour Avenue
Bakersfield, California 93308

(661) 395-0539
FAX (661) 395-3069

Geomega, Inc.
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Attention: Jeff Anderson

Sample Type: Water

Description: VWD-Cymric, CYM-21D1
Sampled by P. Van Middlesworth

Laboratory No: 0211318-1
Date Received: 11/26/02
Date Reported: 12/06/02
Contract No. :
Date Sampled : 11/24/02
Time Sampled : 11:00

REPORT OF ANALYTICAL RESULTS

Constituents	Results	Units	DLR	Method/Ref
Purgeable Aromatics 8020				
Methyl tert-Butyl Ether (MTBE)	0.33	ug/L	0.3	8020/1
Benzene	ND	ug/L	0.3	8020/1
Toluene	ND	ug/L	0.3	8020/1
Ethylbenzene	ND	ug/L	0.3	8020/1
Total Xylenes	ND	ug/L	0.6	8020/1

Analyzed : 12/03/02

JOV

cc:

Method Reference

1. EPA SW-846, 1994 3rd Edition

For *Juan Manuel Alagana*
Robert Cortez, Laboratory Manager

mg/L : milligrams per Liter (parts per million)
ug/L : micrograms per Liter (parts per billion)
umhos/cm : micromhos/cm at 25 C
mmhos/cm : millimhos/cm at 25 C
ND : None Detected N/A : Not Applicable
NSS : Not Sufficient Sample for Analysis
DLR : Detection Limit for Reporting Purposes

REPORT OF ANALYTICAL RESULTS

Client: Larry Bright
Valley Waste Disposal Co.
1400 Easton Dr., #139 B
Bakersfield, CA 93309

Lab Number: 30327
Collected: 01/14/03
Received: 01/15/03
Matrix: Water

Project: McKittrick Water Study
Project Number:
Collected by: Larry Miller

Sample Description:
See Below
Analyzed: 01/21/03
Method: off line, dual inlet

$\delta^{18}\text{O}$ δD

LAB NUMBER	SAMPLE DESCRIPTION	$\delta^{18}\text{O}$ ‰	$\delta^{18}\text{O}$ Dup ‰	δD ‰	δD Dup ‰
30327-1	Sample #1	-5.1*	-5.1	-60	-58

Dup = Duplicate Analysis

*: pH adjusted before oxygen isotope analysis

Submitted by,
ZymaX FORENSICS

Dachun Zhang
Dachun Zhang, Ph.D.
Director, Stable Isotopes

30327o.xls
DZ/ml

QUALITY ASSURANCE REPORT



Client: Larry Bright
Valley Waste Disposal Co.
1400 Easton Dr., #139 B
Bakersfield, CA 93309

Lab Number: 30327
Analyzed: 01/21/03
Method: off line, dual inlet

QA DATA FOR $\delta^{18}\text{O}$

STANDARD	RV	RV _D	ACCEPTANCE LIMIT %
NI	-11.7	-11.6	± 0.15
NI-DUP	-11.7	-11.6	± 0.15

QA DATA FOR δD

STANDARD	RV	RV _D	ACCEPTANCE LIMIT %
ZM	-17	-16	± 1.5
ZM-DUP	-17	-15	± 1.5
NL	-332	-334	± 1.5
NL-DUP	-332	-332	± 1.5

RV = Known reference value for laboratory working standard

RV_D = Daily measurement of reference value

ZM = Zuma Beach sea water

NL = Antarctic ice water

NI = Water

Submitted by,
ZymaX FORENSICS

Dachun Zhang

Dachun Zhang, Ph.D.
Director, Stable Isotopes

30327o.xls
DZ/ml

REPORT OF ANALYTICAL RESULTS

Client: Jeff Anderson Geomega 2995 Baseline Rd., Ste. 202 Boulder, CO 80303	Lab Number: 29904 Collected: Various Received: 12/04/02 Matrix: Water
Project: VWD - Cymric Project Number: C01232A Collected by: Paul VanMiddlesworth	Sample Description: See Below Analyzed: 12/18/02 - 12/27/02 Method: off line, dual inlet

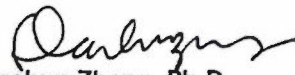
$\delta^{18}\text{O}$ δD				
--	--	--	--	--

LAB NUMBER	SAMPLE DESCRIPTION	$\delta^{18}\text{O}$ ‰	δD ‰	δD Dup ‰
29904-1	21D1	-11.6	-93	-91
29904-2	17N1	-6.0	-65	-64
29904-3	19H1	-4.5	-55	-54

Dup = Duplicate Analysis

29904o.xls
DZ/ml

Submitted by,
ZymaX FORENSICS


Dachun Zhang, Ph.D.
Director, Stable Isotopes

2995 Baseline Rd. Suite 202
Boulder, CO 80303

(303) 443-9111 x. 103

303-442-2549 (phone)
303-938-8123 (fax)

1990-1
-2
-3

Distribution: Original - Accompany Shipment; One copy - Project Manager

 Geomega

QUALITY ASSURANCE REPORT

Client: Jeff Anderson
Geomega
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Lab Number: 29904
Analyzed: 12/18/02 - 12/27/02
Method: off line, dual inlet

QA DATA FOR $\delta^{18}\text{O}$

STANDARD	RV	RV _D	ACCEPTANCE LIMIT ‰
NI	-11.7	-11.6	± 0.15
NI-DUP	-11.7	-11.6	± 0.15

QA DATA FOR δD

STANDARD	RV	RV _D	ACCEPTANCE LIMIT ‰
ZM	-17	-16	± 1.5
ZM-DUP	-17	-18	± 1.5
NL	-332	-331	± 1.5
NL-DUP	-332	-333	± 1.5

RV = Known reference value for laboratory working standard

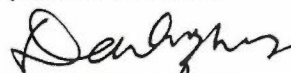
RV_D = Daily measurement of reference value

ZM = Zuma Beach sea water

NL = Antarctic ice water

NI = Water

Submitted by,
ZymaX FORENSICS



Dachun Zhang, Ph.D.
Director, Stable Isotopes

29904o.xls
DZ/ml


2995 Baseline Rd. Suite 202
Boulder, CO 80303

(303) 443-9117 x. 103

303-442-2549 (phone)
303-938-8123 (fax)

Project: VWD - Cymric					Sent To: Zymax Labs - Attn. Allan Jeffrey							
Number:					71 Zaca Ln.							
Sampling Personnel: Paul VanMiddlesworth					San Luis Obispo, CA 93401							
					Date: 12/2/02 (805) 544-4696							
Sample ID	Date	Time	# of Containers	Matrix Type	Sample Filtered? Y/N	Sample Preserved? Y/N	Analyses Requested				Comments	
							del o/H	i isotopes				
21DI	11/24/02	11:00	1	W	N	N	X					Report to Jeff Anderson
17N1	11/25/02	11:30	1	W	N	N	X					
19H1	11/25/02	13:30	1	W	N	N	X					
Relinquished by: Paul VanMiddlesworth			Date: 12/2/02	Time: 13:00	Received by: Dan Parkinson			Date: 12-4-02	Time: 11:02			
Relinquished by:			Date:	Time:	Received by:			Date:	Time:			
Relinquished by:			Date:	Time:	Received by:			Date:	Time:			
Method of Shipment:												

Distribution: Original - Accompany Shipment; One copy - Project Manager

 Geomega

REPORT OF ANALYTICAL RESULTS

Client: Jeff Anderson
Geomega
2995 Baseline Rd., Sta. 202
Boulder, CO 80303

Lab Number: 29904
Collected: Various
Received: 12/04/02
Matrix: Water

Project: VWD - Cymric
Project Number: C01232A
Collected by: Paul VanMiddlesworth

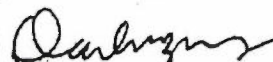
Sample Description: See Below
Analyzed: 12/18/02 - 12/27/02
Method: off line, dual inlet

$\delta^{18}\text{O}$ δD

LAB NUMBER	SAMPLE DESCRIPTION	$\delta^{18}\text{O}$ ‰	δD ‰	δD Dup ‰
29904-1	21D1	-11.6	-93	-91
29904-2	17N1	-6.0	-65	-64
29904-3	19H1	-4.5	-55	-54

Dup = Duplicate Analysis

Submitted by,
ZymaX FORENSICS


Dachun Zhang, Ph.D.
Director, Stable Isotopes

29904a.xls
BZ/ml

QUALITY ASSURANCE REPORT

Client: Jeff Anderson
Geomega
2995 Baseline Rd., Ste. 202
Boulder, CO 80303

Lab Number: 29904
Analyzed: 12/18/02 - 12/27/02
Method: off line, dual inlet

QA DATA FOR $\delta^{18}\text{O}$

STANDARD	RV	RV _D	ACCEPTANCE LIMIT %
NI	-11.7	-11.6	± 0.15
NI-DUP	-11.7	-11.6	± 0.15

QA DATA FOR δD

STANDARD	RV	RV _D	ACCEPTANCE LIMIT %
ZM	-17	-16	± 1.5
ZM-DUP	-17	-18	± 1.5
NL	-332	-331	± 1.5
NL-DUP	-332	-333	± 1.5

RV = Known reference value for laboratory working standard

RV_D = Daily measurement of reference value

ZM = Zuma Beach sea water

NL = Antarctic ice water

NI = Water

29904a.xls
DZ/ml

Submitted by,
ZymaX FORENSICS


Dachun Zhang, Ph.D.
Director, Stable Isotopes



FAX

Fax Number: (303) 938-8123

Company: Geomega

Attention: Jeff Anderson

Date: 12/23/02

From: Julie D. Miller

Number of Pages: 3
(excluding cover sheet)

Additional Comments: Results follow.

Project Name: VWD - Cymric

Project Number: C01232A

ZymaX Lab ID: 29904



71 Zaca Lane
San Luis Obispo CA 93401
phone: 805.544.4696
fax: 805.544.8226
email: zymax@ZymaXusa.com

CHAIR & CUSTODY

[illegible]

Comments 		Relinquished by: Signature <u>Larry Miller</u> Print <u>LARRY MILLER</u> Company <u>Valley Waste Disposal</u> Date <u>1/15/03</u> Time <u>2:15 PM</u>		Received by: Signature _____ Print _____ Company _____ Date _____ Time _____	
Sample integrity upon receipt: Samples received intact <input type="checkbox"/> Samples received cold <input type="checkbox"/> Custody seals <input type="checkbox"/> Correct container types <input checked="" type="checkbox"/>		Relinquished by: Signature _____ Print _____ Company _____ Date _____ Time _____		Received by ZymaX-envirotechnology, inc: Signature <u>K. Burt</u> Print <u>KIM BURT</u> Company <u>ZymaX</u> Date <u>1/15/03</u> Time <u>2:00</u>	
Bill 3rd party: _____ PO#: _____ Quote yes no					